July 1963

FREEZE-DRYING OF FOODS

A list of selected references

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PREFACE

This bibliography covers the period from January 1954 through August 1962, with a few earlier citations and some representative current references indicating the nature and trend of recent development. A basic selection consideration in compiling the bibliography was availability of material in published form.

Although emphasis throughout is on food, some material on general basic principles and historical development has necessarily been included. References to newspaper articles, patents, and articles of exclusively pharmaceutical, biological, or medical nature are excluded. However, it will be noted that the list does include reference to a few books which are primarily concerned with biological or medical aspects of freeze-drying; this exception was made because it was felt that they provide closely related data.

All references except those marked with an asterisk were examined by the compiler.

Grateful acknowledgement is made of the assistance of Kermit M. Bird, Marketing Economics Division, Economic Research Service, in defining the scope of the bibliography and in providing guidance.

Abbreviations for titles of publications cited may be found on pp. 583-614 of U.S. Department of Agriculture Miscellaneous Publication 765, List of Serials Currently Received in the Library of the United States Department of Agriculture, July 1, 1957. The abbreviation "Ref." in an entry indicates that the item contains references to other literature.

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Foster E. Mohrhardt

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National Agricultural Library

INTRODUCTION

Although not a new processing method, freeze-drying has been of interest to the food industry for a relatively short time. Previous to 1940 little work had been done with this drying technique as applied to its possibilities in the food field. Dr. Earl W. Flosdorf, formerly of the University of Pennsylvania and the F. J. Stokes Company, conducted some of the early exploratory work in food freeze-drying. His book, Freeze-Drying, published in 1949, reports results of his and others' research, and contains a bibliography of early writings.

During and after World War II individuals and governments of several European countries became interested in freeze-drying as a food-preservation method. Much basic work in food freeze-drying was sponsored by the Danish Government. The British Government officially opened the Aberdeen Research Establishment in 1951, and much of the fundamental and development work of the 1950's was performed at this station until it closed in 1961. Many innovations that placed freeze-drying in a more favorable cost position were developed at Aberdeen. Work done at that station from 1955 to 1960 is reported in The Accelerated Freeze-Drying Method of Food Preservation.

In more recent years much of the basic food freeze-drying research work has been done in Chicago by the Quartermaster Food and Container Institute for the Armed Forces, Research and Engineering Command. A publication released by the Institute in 1962, Freeze-dehydration of Foods, identifies problems in the field and explores possible solutions.

This bibliography has been compiled as an early step in the economic appraisal of freeze-drying. Begun as a means of surveying literature pertaining to freeze-drying, it soon became evident that a comprehensive search of literature should be done in a systematic and professional manner. It is hoped that this bibliography will aid those searching available literature on the subject of freeze-drying of food. It should help fill the needs of many interested in this rapidly expanding field.

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Dissertations Abstracts, 1954-August 1962
Engineering Index, 1954-1961
Food Science Abstracts, 1954-1957
Industrial Arts Index, 1954-1957
Japanese Periodicals Index, September 1960-December 1961
Nutrition Abstracts and Reviews, 1954-August 1962
Public Affairs Information Service Bulletin, 1954-August 1962
Readers' Guide to Periodical Literature, 1954-August 1962
World Fisheries Abstracts, 1954-August 1962

FREEZE-DRYING OF FOODS

A List of Selected References

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Special Bibliographies Section

1. A. F. D. -- COMMERCIAL progress in Britain and U. S. A. Food Mfr. 36(12):529-530. Dec.1961. 389.8 F736

Summary discussion, including advantages of freeze-dried foods, potential market, design experiments, and commercial activities of specific companies in the United States and abroad.

2. AFD FOODS and their packaging requirements; container research by Metal Box and their new range of containers for AFD products. Food Trade Rev. 32(8):48. Aug.1962. 389.8 F7334

Emphasis is placed on careful consideration of the characteristics of each particular type of product, not only in determining pretreatment but also in effecting best packaging requirements. Discusses collar cans as desirable containers for some AFD foods, and non-metallic packaging for others.

3. ABBOTT, J. A., and THUSE, E. Factors affecting the cost of freeze-drying equipment. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 12(2):135-141, illus. June 1960. 389.9 As74A

After a review of the importance of equipment cost in the freeze-drying process, attention is given to a discussion of specific equipment designs. Cost details are included throughout, in an attempt to arrive at requirements for adequate facilities for economic operation of a commercial plant.

4. ABELOW, I. M., and FLOSDORF, E. W. Improved heat transfer system for freeze-drying. Chem. Engin. Prog. 53(12):597-600, illus. Dec.1957. 381 C4232

Experiments studying the physical data in the process resulted in practical findings of ways to get shorter cycles and more uniform temperature conditions.

5. ACCELERATED freeze. Austral. Food Mfr. & Distrib. 31(3):34. Oct. 5, 1961. 389.8 Au7

Review of a talk given by J. D. Mellor on the new accelerated freeze-drying process. Points covered include advantages of the process, storage data, general development, and outlook.

6. ACCELERATED freeze drying. Internatl. Processed Fruits 4(3):73-75,77-79, illus. 1960. 286.83 In82

Traces the development of dehydration of foodstuffs through the overcoming of specific technical difficulties and gradual resolving of major processing problems. Currently, attention is centering on selection of foodstuffs and packaging requirements.

7. ACCELERATED freeze-drying. Mod. Refrig. 63(749):808-809, illus. Aug. 1960. 295.8 M72

Shows how recent developments have made freeze-drying commercially feasible. Advantages of the process are

given, and the article covers details of processing, including equipment details and research on heating (especially infrared) and drying.

8. ACCELERATED freeze drying; a new Irish food-processing industry. Foreign Agr. 25(9):16. Sept.1961. 1.9 Ec7For

Describes the current and proposed scope, plans, and economic implications of the Irish Sugar Company's new AFD plant at Mallow. Its main outlet is to be export trade; and its potential for farmers, laborers, and the Irish economy as a whole is promising. A brief reference to some other freeze-drying activities throughout the world is included.

9. ACCELERATED freeze drying of foods. Engineering 192(4973 i. e. 4975): 226-227, illus. Aug. 25, 1961. 290.8 En322

Gives details of extensive research carried on at the A/S Atlas firm in Copenhagen. Discusses and evaluates the three types of heat transfer (contact, radiation, and high frequency), the design of drying plants, and describes the operation of a Swedish packaging machine for freeze-dried items. New developments are suggested, and future outlook for the process is considered promising.

10. ADACHI, R. R., SHEFFNER, L., and SPECTOR, H. The in vitro digestibility and nutritional quality of dehydrated beef, fish and beans. Food Res. 23(4): 401-406. Ref. July/Aug.1958. 389.8 F7322

For the investigation, beef and haddock were frozen and freeze-dehydrated, and Navy, red kidney, and baby lima beans were precooked, frozen and dehydrated in a Proctor and Schwartz through-air-flow tray dehydrator. Among the results reported, it was found that there was no decrease in nutritional value of proteins in these food products.

11. ADVANCES in freeze-drying and irradiation cited. Food Engin. 29(6): 100,103, illus. June 1957. 389.8 F737

The Institute of Food Technologists, in reviewing recent studies on freeze-dried meats, seafood, lima beans, and strawberries, is looking forward to a breakthrough within three years; that is, as soon as high through-put equipment is developed to make operations continuous, thus reducing operating time.

12. ADVANCES in processing methods. Food Engin. 34(2):37-52, illus. Feb. 1962. 389.8 F737

Contains two short sections relative to freeze-drying: one is about microwave heating, p. 38; and the other about latest developments in equipment in freeze-drying plant systems, p. 43.

13. AITKEN, A., and others. Effect of drying temperature in the accelerated freeze-drying of pork. J. Sci. Food & Agr. 13(8):439-448, illus. Ref. Aug.1962. 382 So12

J. C. Casey, I. F. Penny, and C. A. Voyle, joint authors.

Experiment is reviewed in detail, accompanied by tables showing the effect of the drying temperature: on pH, water-soluble protein, glucose; on the activity of phosphorylase and ATP-ase; and outlining the taste panel's scoring of the odor, flavor, and texture of the pork dried at different temperatures. The study showed that the temperature at which meat is dried by the AFD process affects considerably the properties of the resulting food item.

14. AND SO are cans [suitable for many applications]. Food Mfr. 37(4): 158. April 1962. 389.8 F736

Metal Box Company laboratories have been conducting research on suitable packaging for freeze-dried foods. Open top cans are considered satisfactory, and for certain items cartons and laminates have been developed.

15. ANDERSEN, K. A. How Liana freeze-dries shrimp - and plans full line of sublimated food products. Canner/Packer 130(5):23-24, illus. May 1961. 286.83 C16

Includes shipping data, as well as current and potential marketing outlets.

16. ANDERTON, J. I. Manufactured soups. Nutrition 15(2):98-102. Summer 1961. 389.8 N959

Includes discussion of developments in freeze-drying, indicating its increasing application in preparation of dried soup ingredients. Points out flavor retention and virtually unimpaired nutritive value of foodstuffs dried by this process.

17. ANET, E. F. L. G., and REYNOLDS, T. M. Chemistry of non-enzymic browning. I. Reactions between amino acids, organic acids, and sugars in freeze-dried apricots and peaches. Austral. J. Chem. 10(2):182-192. Ref. May 1957. 475 Au73

Examination of the water-soluble constituents of apricot and peach purees before and after storage for four to sixteen months at 25° C and 70 percent relative humidity.

18. ANET, E. F. L. J., and REYNOLDS, T. M. Reactions between amino-acids, organic acids and sugars in freeze-dried apricots. Nature [London] 177 (4519):1082-1083. June 9, 1956. 472 N21

Freeze-dried apricot puree, stored at 25° C, and 70 percent relative humidity for 16 months, became mid-brown in color. Other characteristic changes are described.

Abstract in Food Sci. Abs. 28(6):618. Dec.1956. 241.64 G792

19. ANGEL, T. H. Packaging of freeze-dried foods. Food Mfr. 37(4):157-158, illus. Apr.1962. 389.8 F736

Points out superiority of aluminum foil as flexible packaging for freeze-dried foods; details the specific problems to be solved in making the best containers for these new food items; and lists specifications of satisfactory foil laminates recommended for: Unprotected blocks, unprotected pouches, and pouches protected by a carton. Caution is suggested, however, that more specialized packaging and laminates may be necessary for many freeze-dried food items.

20. ANGLEMIER, A. F., CRAWFORD, D. L. and SCHULTZ, H. W. Improving the stability and acceptability of precooked freeze-dried ham. Food Technol. 14(1): 8-13. Ref. Jan.1960. 389.8 F7398

Describes experiments modifying such factors as: Curing methods, curing ingredients, timing, temperature, and precooking conditions. Results failed to produce freeze-dried ham of any greater storage stability than that of commercially cured ham used in the studies. Its general deterioration, especially in color and flavor during storage, lessens its acceptability.

21. ARMOUR introduces freeze-dried meals. Food Engin. 33(6):81, illus. June 1961. 389.8 F737

Description of first line of freeze-dried foods to be marketed by Armour. Labelled Star Lite, they include beefsteaks, pork chops, ham patties, chicken stews, and scrambled eggs. Suggested prices are listed; favorable and disadvantageous features are revealed; and packaging, production plants, and outlook are touched on briefly.

22. ARMOUR markets freeze-dried line. Food Business 9(7):32-33, illus. July 1961. 389.8 F7342

Current outlet for new Star Lite line is through sporting goods stores, department stores, and direct mail, with campers and outdoorsmen as potential buyers. Includes list of available foods. An explanation of freeze-drying process accompanies article.

23. ARMOUR'S star shines brighter with new freeze-dried foods. Natl. Provisioner 145(1):12, illus. July 1, 1961. 286.85 N21

Describes briefly freeze-drying techniques and characteristics of resulting foodstuffs in this newly developed line of foods now being distributed under the brand name of Star Lite. Included in this new line are: Beefsteaks, pork chops, ham patties, chicken stew, and scrambled eggs.

24. ARMY hopes to boost soldier combat morale with freeze-dried meals behind lines. Quick Frozen Foods 25(4):101-102, illus. Nov.1962. 389.8 Q4

These quick-serve meals are wrapped in disposable tinfoil-laminated

cartons, which serve as kettles for the food items. There are now seven test entrees: Chicken with gravy; chili con carne with beans; spaghetti with meat and tomato sauce; beef in onion gravy with rice; meatballs with brown gravy; Swiss steak; sliced beef loaf with tomato gravy. It is expected that freeze-dried meals will be mass-produced by 1963.

25. ARNOLD, L. K., and HSIA, P. R. Drying fish and beef prior to solvent extraction. J. Agr. Food Chem. 6(3): 231-232. Ref. Mar.1958. 381 J8223

A comparison of undried and freeze-dried fish and beef revealed that the freeze-dried foods extracted more rapidly than the undried.

26. ATLAS accelerated freeze-drying plant. Food Trade Rev. 31(11):39-40,44, illus. Nov.1961. 389.8 F7334

Traces steps leading to development of current type of freeze-drying plant by A/S Atlas of Copenhagen. Discusses heat transfer techniques, vacuum equipment, design of plants, and packaging problems.

27. AUERBACH, E., and others. A histological and histochemical study of beef dehydration. V. Some factors influencing the rehydration level of frozen-dried muscle tissue. Food Res. 19(5):557-563, illus. Ref. Sept./Oct. 1954. 389.8 F7322

H. Wang, N. Maynard, D. M. Doty, and H. R. Kraybill, joint authors.

The following factors were studied: Muscle fiber orientation in relation to absorbing surfaces, thickness of muscle tissue sample, temperature, pH, and osmotic pressure of rehydrating fluid and vacuum rehydration.

28. AUERBACH, E. Meat preservation: Dehydration. In American Meat Institute Foundation. The science of meat and meat products, p. 295-298. San Francisco, Freeman, 1960. 389 Am38S

Section on freeze-drying covers processing, its effect on muscle tissues, storage stability, and rehydration methods.

29. BAIRD, D. Packaging Association of Canada. Canad. Food Indus. 33(4):26-29. Apr.1962. 286.83 C166

Includes summaries of four papers on freeze-drying: R. C. Wornick discusses the basic principles of the process, cost reduction, and types of available equipment; H. P. Furgal centers his emphasis on packaging problems of such food items as meat, fish, mushrooms, including reference to deteriorative changes in storage and potential cost savings; J. H. Nair reviews progress on the application of freeze-drying being carried on by companies in the U. S., Canada, and Europe, and a consideration of marketing problems; W. R. Smithies reports on future potential for processing of meats, fish, vegetables, and fruits.

30. BAKER, L. C., LAMPITT, L. H., and BROWN, K. P. Connective tissue of meat. III. Determination of collagen in tendon tissue by the hydroxyproline method. J. Sci. Food & Agr. 5(5):226-231. May 1954. 382 So12

Freeze-dried beef tendon powder was used in the investigation.

31. BAKER, L. C., LAMPITT, L. H., and MEREDITH, O. B. Solanine, glycoside of the potato. III. An improved method of extraction and determination. J. Sci. Food & Agr. 6(4):197-202. Apr.1955. 382 So12

Raw and cooked freeze-dried potatoes were used for one of the comparison studies.

32. BALLANTYNE, R. M., and others. Dehydrated cooked meat products. Food Technol. 12(8):398-402, illus. Ref. Aug.1958. 389.8 F7398

C. Brynko, A. J. Ducker, and W. R. Smithies, joint authors.

The study deals with experimental determination: 1, Of the value of spiked-plate method of freeze-drying, compared with conventional freeze-drying method; 2, of a comparison between freeze-drying and hot-air drying methods in preparation of cooked meat. Concludes that cooked meat items can be freeze-dried by spiked plates in four hours and that freeze-drying has practically no advantage over hot-air drying of cooked ground beef.

33. BALLANTYNE, R. M., and others. Factors influencing the quality of freeze-dried foods. (Abs.) Food Trade Rev. 31(6):56. June 1961. 389.8 F7334

T. S. Blakley, A. J. Ducker, and W. R. Smithies, joint authors.

Flavor, color, texture, and juiciness may all be affected by adverse processing conditions. Method of freezing, degree of thawing, temperature changes, and storage conditions all affect the resulting product.

34. BALLANTYNE, R. M., and others. Prepared foods for the Canadian Armed Services. Food Technol. 12(9):470-472. Sept.1958. 389.8 F7398

J. Galbraith, J. H. Hulse, W. R. Smithies, and N. E. Stacey, joint authors.

In view of the need for a revised approach to military feeding, factors relating to large-scale production of dehydrated foods have been studied. Development work with freeze-drying equipment and facilities, including estimated costs, is discussed.

35. BARD, G. W. Is continuous freeze-drying practical? In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p. 86-92, illus. Chicago, 1961? 389.3 R31

Includes description of equipment, processing conditions, some cost data, and advantages of continuous over batch drying. Concludes that continuous method is practical if demand for product is large enough to utilize equipment to maximum capacity; however, with discrete particles, batch system is preferable. In all cases it is cautioned that each individual product must be judged on its own considerations.

36. BARKER, J., GANE, R., and MAPSON, L. W. The quality of green peas dried in the frozen state. Food Mfr. 21(8):345-348. Aug. 1, 1946. 389.8 F736

Describes experiments performed in 1939 and 1940 comparing freeze-drying technique with ordinary freezing method of preserving peas. Results were favorable for freeze-dried peas; and although their production cost would be greater, it was pointed out that marketing advantages would offset this.

37. BARTLETT, J. R. Accelerated freeze drying. MGA Bulletin 140:341. Aug.1961. 80 M97

An explanation of, and brief introduction to, the process being perfected at Vickers-Armstrongs factory at Swindon.

38. BATZER, O. F., and others. Precursors of beef flavor. J. Agr. Food Chem. 8(6):498-501. Ref. Nov./Dec. 1960. 381 J8223

A. T. Santoro, M. C. Tan, W. A. Landmann, and B. S. Schweigert, joint authors.

A diffusate from the water extract of uncooked ground beef was lyophilized in the study.

39. BENDER, A. E. Freeze-dried food. Chem. & Indus. 9:389-391. Mar. 3, 1962. 382 M31C

A discussion of work accomplished in accelerated freeze-drying at the Research Establishment at Aberdeen. Reference is also made to current commercial interest and activity in the freeze-drying process in Ireland and the United States. Problems and future possibilities of the process are included.

40. BENSON, C. S., and RAGLE, R. H. Project "Jello"; SIPRE Greenland Expedition 1955. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 9(1):8-23. Mar.1957. 389.9 As74A

The foods taken were special dehydrated and frozen foods provided by the Quartermaster Food and Container Institute of Chicago. The article summarizes the experience of the men with each of the dehydrated food items, and an extended "comment" appendix gives individual personal reactions of the men to the items. A list of the types and amounts of foods taken on the trip is included. Dehydrated pork chops, steaks, cabbage, green beans, potatoes, eggs, cheese, milk, soups, and fruit juices were included in the menus.

41. BETTER "economic picture" is needed to spur freeze-drying, Quartermaster Conference hears. Frosted Food Field 33(4):40. Oct.1961. 389.8 F922

High cost of equipment and current lack of a continuous process for commercial operations are major items of concern here. However, almost all large food processing companies in the United States now have freeze-drying equipment for use in pilot plant operations or for small commercial runs.

42. BIRD, K. M. F-D report. Washington, U. S. D. A. Econ. Res. Serv. Mktg. Econ. Div., Sept.1962-Apr.1963. 4 pts.

Contents: Pt. 1, Freeze-drying - progress and problems; Pt. 2, Freeze-drying expectations; Pt. 3, Freeze-dried poultry; Pt. 4, A directory of freeze-drying: Food processors, equipment firms, and others.

43. *BIRD, K. M. Freeze-drying costs. Washington, U.S.D.A. Econ. Res. Sect. Mktg. Econ. Div. B. [To be published August 1963]

Shows costs of operating freeze-drying plants in four volume capacities. Costs range from about 2 1/2 cents to seven cents per pound of water removed, depending upon food being dried, hours per day, days per year, wage and utility levels, and other factors.

Based on costs anticipated in the future, volumes of freeze-drying expected in 1967 are about $224 million per year.

44. *BIRD, K. M. Palatability tests of freeze-dried foods. Washington, U.S.D.A. Econ. Res. Sect. Mktg. Econ. Div. B. [To be published June 1963]

Gives results of taste tests of 28 commercially available freeze-dried foods. Food items testing highest include soups, shellfish, and prepared mixes.

45. BISHOV, S. J., HENICK, A. S., and KOCH, R. B. Oxidation of fat in model systems related to dehydrated foods. Food Res. 25(2):174-182. Ref. Mar./-Apr.1960. 389.8 F7322

Exploratory investigation carried on in attempt to gather background data on rates of reaction of fat and other food components in freeze-dried foods.

46. BISHOV, S. J., HENICK, A. S., and KOCH, R. B. Oxidation of fat in model systems related to dehydrated foods. II. Composition and position of dispersed lipid components and their effect on oxidation rates. J. Food Sci. 26(2):198-203. Ref. Mar./Apr.1961. 389.8 F7322

The studies were undertaken to develop new approaches to increase the storage life of freeze-dried rations.

47. BLAINE, J. E. Pilot freeze-drying equipment, production drying cycles, and their control. In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p. 73-77. Chicago, 1961? 389.3 R31

Includes discussion of automatic control systems.

48. BLAIR, J. M. Development of dehydrated foods -- some technological complexities. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 9(4):280-285, illus. Jan.1958. 389.9 As74A

Detailed discussion of freeze-dehydration of meats.

49. BLAIR, J. M. Freeze-dehydration--new technique considered for military meat preservation. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 6(3):137-141, illus. Oct. 1954. 389.9 As74A

Discusses development in program to produce successful dehydrated foodstuffs for military use. Covers the general principles of the new process itself, data on storage, packaging, and problems to be solved.

50. BONEM, F. L. Freeze-drying equipment round up. Food Processing 21(11):72-77, illus. Nov.1960. 389.8 F7325

Information obtained from equipment manufacturers at the recent Military-Industry Conference on Freeze-drying is presented here in the form of a list of domestic and foreign suppliers of equipment, and also of companies

*Not examined

offering test facilities. For each company a summary is given of what specifically is available, together with other brief pertinent data.

51. BRADFORD, E. A. M. El secado de los alimentos pro congelacion acelerada [Accelerated freeze-drying of food]. Annona 5(60):30-33, illus. Dec.1960. 281.8 An73

Discussion of developments exemplified by the Establishment of the Aberdeen Experimental Station and the Irish Sugar Company plant at Mallow. Includes reference to scientific equipment, engineering developments, rehydration, and potential marketing outlets.

52. BRIGHT future painted for dehydro-freezing, freeze drying. Frozen Food Age 9(9):7. Apr.1961. 389.8 F934

Brief coverage of definition, potential, and advantages of the new processes.

53. BROCKMANN, M. C. Dehydration. In Midwest Research Institute. The future of food preservation. p. 43-53. Kansas City? Mo., 1957. 389.9 M582

Discussion of freeze-drying here covers technical details of the process, a consideration of its advantageous features, its storage stability, its suitability for specific food items, and optimistic outlook.

54. BROCKMANN, M. C. Freeze-dried meat, poultry, and fish. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 11(3):158-160. Sept.1959. 389.9 As74A

The work of the Institute Meats Products Branch is covered. The obstacles to be overcome are included, as are the current studies on characteristics of freeze-dried products. At the time of writing, development of about 30 meat, poultry, and fish items for use in meals was in progress.

55. BROCKMANN, M. C. Improving product rehydrating - basic biochemical and biophysical approaches. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p.235-237. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

The moderator's summation of the papers presented at this session of the conference. He lists the factors which influence the level of rehydration, and points out the need for more knowledge of the nature of the processes involved in order that operations may be controlled by objective methods.

56. BROCKMANN, M. C. New perspective on freeze dehydration. Food Processing 18(5):22. May 1957. 389.8 F7325

A report from a symposium of Midwest Research Institute on the future of food preservation. The advantages of freeze-dried products make them especially important to the military, and of interest to campers.

57. BROCKMANN, M. C. Objective product testing methods - meat and marine products. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 11(3): 174-175. Sept.1959. 389.9 As74A

Although some investigative physical and chemical tests are being pursued on freeze-dried meats at the University of Illinois, there is currently a lack of evaluative techniques with regard to performance characteristics of new freeze-dried products.

58. BROCKMANN, M. C., and TUOMY, J. M. Operational factors influencing the efficiency of freeze drying. (Abs.) Food Technol. 14(4):Insert 28. Apr.1960. 389.8 F7398

In addition to the usual factors (i. e. material to be dried, equipment, processing conditions) to be considered in appraising the efficiency of freeze-drying, attention is drawn to the three phases of the drying process itself. Emphasis is to be placed on a closer study of, and improvement in, the slow withdrawal of moisture during the third phase in influencing the efficiency of the freeze-drying process.

59. BROCKMANN, M. C. Time requirements for processing freeze dehydrated foods. Internatl. Cong. Refrig. Proc. 10(3):35-39. Ref. 1959, pub. 1960. 295.9 In82

Describes the advantages of freeze-

dried foods for the military. Attention to reducing the time of the third phase of the drying process is suggested as the best possibility for economic advantage here.
Summary in Internatl. Inst. Refrig. B. 39(3):876. 1959. 295.9 In7

60. BROOKS, J. The structure of the animal tissues and dehydration. (Abs.) Food Mfr. 33(5):204. May 1958. 389.8 F736
Results of the study showed that uncooked freeze-dried chops and steaks were drier and tougher than frozen meats.

61. BRYNKO, C., and SMITHIES, W. R. Meat dehydration - by rapid vacuum freeze-drying. Food Canada 16(10, i. e. 11):25, illus. Nov.1956. 389.8 F7323
A review of various methods of freeze-drying, pointing out that the use of spiked heating plates, developed at the Defence Research Medical Laboratories, Toronto, has proved highly successful.

62. BRYNKO, C., and SMITHIES, W. R. Rapid vacuum freeze-drying of meat. J. Sci. Food & Agr. 9(9):576-583, illus. Ref. Sept.1958. 382 So12
Describes method of freeze-drying portions of beef and pork by laying the pieces between heated spiked plates. By the use of this method, thicker slices of meat and fish can be rapidly dehydrated in a convenient and efficient way.

63. *BUCK, P. Freeze-dried foods need better packages. Food & Drug Packaging 4(4):10. Feb. 16, 1961. 280.38 F733

64. BURKE, R. F. Engineering aspects of freeze drying. (Abs.) Agr. Engin. 43(9):511,530, illus. Sept.1962. 58.8 Ag83
Includes reference to equipment details and control system. States that future potential of this new process depends on successful development in the use of existing equipment, rather than on development of radical, new equipment.

65. BURTON, P. A. F.-D. equipment. Frozen Foods 14(9):611,613-614, illus. Sept.1961. 295.8 Q4
Traces the steps in freeze-drying process, with a description of heating methods available and drying cycle data.

66. BURTON, P. Application of freeze-drying to the preservation of food. Food Indus. So. Africa 14(8): 27-28. Jan.1962. 389.8 F7372
Although freeze-drying has become a most attractive method of dehydrating foods, its high cost has made it uneconomical. Attention has, therefore, centered around improving drying rate by developing more successful techniques of heat transfer. Article gives details of drying cycle by direct contact method (with added use of metal mesh). Brief reference is made to the use of radiant and dielectric heating techniques. Two inserts give, respectively, a cursory run-down of developments to date in the first commercial AFD plant in Eire, and also a brief review of current activities in freeze-drying by major food companies in the United States.

67. BUTLAND, P. Mechanical cleaning for top quality. Canad. Food Indus. 32(10):26-27. Oct.1961. 286.83 C166
Discussion of preparation of wild blueberries for market. A short section reports on the successful use of freeze-drying as a method of preservation here.

68. CAGE, J. K. Packaging freeze-dried foods. Mod. Packaging 36(4):153-154,210-211, illus. Dec.1962. 309.8 M72
Reviews the critical requirements in developing satisfactory containers, and describes basic success obtained through use of a high-barrier vacuum pouch with a partial gas flush.

69. CALLOWAY, D. H. Dehydrated foods. Nutr. Rev. 20(9):257-260. Sept. 1962. 389.8 N953
Includes effect of freeze-drying on nutritive value of processed foods, as revealed by various studies with beef, pork, chicken, and shrimp. Data are also given for other methods of dehydration. General conclusions showed

*Not examined

that nutrient content depends on preparatory treatment and process, as well as on breed (or variety) and conditions of growth and harvesting.

70. CAMPBELL adds dry soup. Business Wk. 1668:111, illus. Aug. 19, 1961. Libr. Cong.
Reports new freeze-dried line under brand name Red Kettle, comprised of seven varieties and packaged in aluminum containers.

71. CAMPBELL creates dry soup line. Food Engin. 33(9):46-47, illus. Sept. 1961. 389.8 F737
Seven new freeze-dried soup mixes have brand name of Red Kettle. They contain beef, chicken, mushrooms, and vegetables. The packaging is described in some detail. Plans for other freeze-dried items are mentioned.

72. CAMPBELL soup mixes appear in tear-strip aluminum cans. Food Field Rptr. 29(17):36, illus. Aug. 28, 1961. 286.83 F73
Red Kettle is the brand name of the recently developed soups with freeze-dried ingredients. This quality line of dry-soup mixes will be distributed on a market-to-market basis at first before being made available throughout the country.

73. CAMPBELL'S Red Kettle: it brews more than soup. Food Business 9(10): 18-19,37, illus. Oct.1961. 389.8 F7342
The new freeze-dried soup line, packaged in aluminum containers, provides new competition in the dry-soup market and opens new "tin" vs. aluminum confrontation for the canning business.

74. CAMPBELL'S [freeze dried] soup in aluminum. Mod. Packaging 35(1):129, illus. Sept.1961. 309.8 M72
Description of unique container for new freeze-dried line.

75. CANS that open without can-opener or key. Food Processing 23(4): 9, illus. Apr.1962. 389.8 F7325
A description of new containers being used by Wilson & Company in marketing their first freeze-dried products: Steaks, hamburgers, and pork chops.

76. CARMAN, P. C. Some basic principles of freeze-drying and molecular distillation. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 77-84. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53
A technical discussion. Paper concludes that there is little point in going beyond normal evaporative distillation in freeze-drying practice.

77. CASOLI, U. La crioessiccazione dei prodotti alimentari [The freeze-drying of foods]. Indus. Conserve 37(2):91-106, illus. Ref. Apr./June 1962. 389.8 In23
English summary.
An extensive coverage, including: Brief historical background, basic operations and theory, a consideration of some of the outstanding plants throughout the world, development to date, economic aspects, and future outlook.

78. CASSELL, M. S. Vacuum freeze dehydration process enters market. Indus. Refrig., Jan.1961:14-15,18-19, illus. 295.8 Ic2
Based on discussion of the subject by the president of Vacudyne Corporation, which designs, manufactures, and installs the equipment. It was pointed out that the freeze-dry system does not replace refrigeration except during shipping and storage periods. Reference is made to freeze-dry installation in the United States Army Quartermaster Depot.

79. CEKATAINER packaging system for freeze-dried foods. Food Trade Rev. 31(12):62, illus. Dec.1961. 389.8 F7334
Describes operation of the system (now in production), shows how it solves all major packaging requirements, and points out further advantages in warehouse-storage and marketing of the finished product.

80. *CEKAVAC lined carton system could be used for AFD foods. Packaging News 7(10):26. Oct.1960. Not in Natl. Agr. Libr.
Describes steps in suggested method

*Not examined

of packaging.
Abstract in Packaging Abs. 18(1):35. Jan.1961. 309.8 P122

81. *CHARM, S. E. Fundamentals of food engineering. Westport, Conn., Avi, 1963? Not in Natl. Agr. Libr.
Freeze-drying, Ch. 9.

82. CHICHESTER, C. O. Improved instrumentation for freeze-drying operations - exploring new approaches. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 232-235. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53
The moderator's summation of the papers presented in this session of the conference. Areas which require further investigation are indicated.

83. CHICHESTER, C. O., SHARRAH, N., and SIMONE, M. Instant bread mix: Studies on the dehydration of flavoring materials. Food Technol. 14(12):653-656. Dec.1960. 389.8 F7398
Discusses the application of three drying principles (freeze, spray, and drum) to a fermented broth, which was to be used eventually in combination with an instant bread mix in making a baked product with good flavor. Experimental procedures and detailed tables are included. All three techniques proved successful in producing dried bread-flavoring materials with acceptable storage stability.

84. CHICHESTER, C. O. Problems encountered in freeze-drying of fruit. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 10(2):89-91. June 1958. 389.9 As74A
One of the main difficulties, transfer of heat energy, is discussed, with special attention given to the advantages and disadvantages of dielectric heating.

85. CHICHESTER, C. O. The storage stability of freeze dried peaches. (Abs.) Food Technol. 10(5, sup.):22. May 1956. 389.8 F7398
Comparison, over a period of 120 days, of the rate of deterioration of freeze-dried peaches and conventionally-dehydrated peaches at a storage temperature of 110° F.

86. CLEMENTS, R. L. A simple and efficient trap for freeze-drying and similar applications. Analyt. Biochem. 3(1):87-90, illus. Jan.1962. 381 An13
Describes and illustrates an assembly that has been in continuous use for drying citrus peels.

87. CLIFCORN, L. E. An appraisal of new processing methods for military foods. Food Technol. 13(3):176-179. Ref. Mar.1959. 389.8 F7398
Includes one paragraph surveying the general developments and potential of freeze-drying as a new method of food dehydration.

88. COLE, L. J. N. Comparative effects of 2, 4-dinitrophenol on the actomyosin adenosine triphosphatase from fresh, frozen, and freeze-dried beef. Nature [London] 192(4809):1288-1289. Dec. 30, 1961. 472 N21
The study, conducted at the Defence Research Medical Laboratories, Toronto, was designed to detect aging changes in beef. A comparative table accompanies the article.

89. COLE, L. J. N. A comparison of the effects of freezing and drying on the rehydratability of freeze-dried beef. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 217-224. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53
A discussion of a series of investigations studying changes at molecular level.

90. COLE, L. J. N. The effect of storage at elevated temperature on some proteins of freeze-dried beef. J. Food Sci. 27(2):139-143. Ref. Mar./Apr. 1962. 389.8 F7322
Describes two series of experiments conducted at the Defence Research Medical Laboratories in Toronto. A moisture-free atmosphere was used in the studies. Primary interest was in determining whether two enzymes, each representing a different group of proteins, were affected equally by storage, and in studying the effect on the

*Not examined

"solubility" of different components.

91. COLE, L. J. N., and SMITHIES, W. R. Methods of evaluating freeze-dried beef. Food Res. 25(3):363-371. Ref. May/June 1960. 389.8 F7322
Discusses conventional and accelerated freeze-drying techniques and their effects on beef.

92. COMMERCIAL freeze-drying expands in U. S. and Europe. Food Engin. 34(5): 123. May 1962. 389.8 F737
Reviews briefly new facilities and production trends of specific food companies in Ireland, Sweden, and Italy, among others.

93. CONNELL, J. J. The effect of drying and storage in the dried state on some properties of the proteins of food. In Society of Chemical Industry. Fundamental aspects of the dehydration of foodstuffs, p. 167-177. Ref. London, 1958. 389.3 So1
Reviews many studies attempting to explore reactions underlying textural deterioration in foods. Among foodstuffs investigated here was freeze-dried fish. It is believed that the freeze-drying process may be the gentlest way of drying proteins. However, it was reported that the texture of dehydrated fish (vacuum-dried or freeze-dried) becomes drier and tougher quickly after only moderate storage.

94. CONNELL, J. J. The effects of freeze-drying and subsequent storage on the proteins of flesh foods. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 50-58. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53
Detailed studies and observations on beef and cod are reported. The general conclusion reached here is that damage to proteins as a result of freeze-drying is much less than was at first believed, and eventually may be eliminated.

95. CONNELL, J. J. Some aspects of the texture of dehydrated fish. J. Sci. Food & Agr. 8(9):526-537, illus. Ref. Sept.1957. 382 So12
Freeze-dried cod was used throughout the investigation.

96. *CONROY, A. The freeze-drying and subsequent storage of animal products. Davis, California, 1955. Not in Natl. Agr. Libr.
Thesis (M.S.) - University of California.

97. CONTRIBUTIONS of r & d contracts to military dehydrated meat investigations. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 7(3):200-203. Oct.1955. 389.9 As74A
A review of the studies points to freeze-drying as a satisfactory technique for dehydration of the future. Obstacles to be overcome here include: Equipment cost, lengthy drying cycles, packaging requirements, cooking techniques, and raw material requirements.

98. COPSON, D. A., and DECAREAU, R. V. Microwave energy in freeze-drying procedures. Food Res. 22(4): 402-403. July/Aug.1957. 389.8 F7322
The study shows that by freeze-drying beefsteak through the use of microwave energy at 2450 mc a uniform radio frequency heating is achieved. An advantage to using microwave energy is that it permits rapid dehydration of certain products not handled well by conventional processes.

99. COPSON, D. A. Microwave sublimation of foods. Food Technol. 12(6): 270-272. June 1958. 389.8 F7398
Discussion of operating conditions of microwave freeze-drying. Study reveals direct relationship between sublimation rates and microwave energy supplied.

100. CUTTING, C. L., REAY, G. A., and SHEWAN, J. M. Dehydration of fish. Gt. Brit. Food Invest. Bd. Spec. Rpt. 62, 160 p. 1956. 389.9 G792
Reference to freeze-drying, p. 11-13,67,95,100,111,144. Concerned primarily with reconstitution of freeze-dried raw fin and freeze-dried minced, cooked fish, with discussion of texture, flavor, and general reconstitution capabilities.

*Not examined

101. CZULAK, J., and HAMMOND, L. A. Freeze-dried starter cultures. Austral. J. Dairy Technol. 8(3):89-91, illus. July/Sept.1953. 44.8 Au74

Description of tests with freeze-dried starter cultures. Results proved that freeze-drying preserves the activity of the starters. Procedures are listed for reviving freeze-dried cultures in the cheese factory.

102. DALGLEISH, J. M. Accelerated freeze-drying. I. Developments to date. Food Mfr. 36(2):56-59. Feb. 1961. 389.8 F736

Historical review of the processes, achievements, and trend of experimental work at the Aberdeen Research Establishment of the Ministry of Agriculture, Fisheries, and Food.

103. DALGLEISH, J. M. Automatic control of the freeze-drying process and predetermination of quality. (Abs.) Food Trade Rev. 32(11):37. Nov.1962. 389.8 F7334

Discusses basic factors in controlling quality, and the combination of steps necessary to establish an optimum drying cycle to give a defined quality.

104. DALGLEISH, J. M. C.Q.C. system for freeze-drying foods. Food Trade Rev. 31(11):41-42, illus. Nov.1961. 389.8 F7334

Discusses features and method of operation of Leybold Controlled Quality Continuous freeze-drying plants. The first plant of this type, now being built, is to be located in Italy.

105. DALGLEISH, J. M. A short guide to freeze-drying. Food Mfr. 37(4): 148,151-156. Apr.1962. 389.8 F736

Discussion covers: Classification of foods that lend themselves to the new process; preparation and pretreatment suggested for fruits, vegetables, meat, and fish; details of the process itself, including plant design, instrumentation, and operation; packaging requirements and possibilities; storage testing; and reconstitution problems. Includes insert diagram with detailed narrative explanation of new continuous system by Vickers-Armstrongs.

106. DECAREAU, R. V. How microwaves speed freeze-drying. Food Engin. 33(8): 34-36, illus. Aug.1961. 389.8 F737

Five advantages of microwave freeze-drying are listed. A detailed table showing comparative costs for conventional, microwave, and dual energy processing methods supplements the narrative. The analysis indicates that the dual energy system offers the most economical process.

107. DECAREAU, R. V. Limitations and opportunities for high frequency energy in the freeze-drying process. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 147-162, illus. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

Discussion is accompanied by several tables: One shows detailed cost comparison basis for microwave process, for conventional process, and for dual energy process; another compares costs of freeze-drying beefsteak by the three methods. The dual energy process was found to offer promise as an economical freeze-drying method.

108. DEHYDRATED food looks ahead. Business Wk. 1624:77-78,80,82. Oct. 15, 1960. Libr. Cong.

Review of freeze-drying developments to date, including a rundown of the activity of many commercial firms in the United States and abroad. Problems and drawbacks are discussed, varying opinions are recorded, and general outlook is surveyed. Military interest in the new technique is also covered briefly.

109. DEHYDRATED meat. Food [London] 27(321):218. June 1958. 389.8 F738

Studies with freeze-dried beefsteaks and pork chops show that stability of vitamins in them is as good as, if not better than, that in fresh beef and pork. Specific conclusions are given in detail.

110. DEHYDRATION comes back. Mod. Packaging 34(11):89-94,202, illus. July 1961. 309.8 M72

Reviews the progress to date on packaging of freeze-dried food items, pointing out general and specific problems involved. Current practice in packaging details for items now on the market is discussed, and considerations for future plans are optimistic.

111. DEIBEL, R. H., WILSON, G. D., and NIVEN, C. F. Microbiology of meat curing. IV. A lyophilized Pediococcus cerevisiae starter culture for fermented sausage. Appl. Microbiol. 9(3):239-243, illus. Ref. May 1961. 448.3 Ap5

Presents a laboratory method of testing the activities of starter cultures. This culture was found to be useful for commercial production of a variety of fermented sausages.

112. DESROSIER, N. W. The technology of food preservation, p. 149-153, illus. Ref. Westport, Conn., Avi, 1959. 389.3 D47

Coverage includes: Details of the freeze-drying process (i.e. temperature changes, water content, time); a comparative table showing differences between conventional drying and freeze-drying; reference to quality and nutritive value of freeze-dried fruits and milk.

113. DOTY, D. M. Increasing product storage life -- Basic deteriorative reactions. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 228-231. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

Summarizes data produced in oxidative and non-oxidative reactions. Points out basic importance here of temperature, moisture level, and packaging conditions.

114. DUCKWORTH, R. B., and SMITH, G. M. Diffusion of glucose during vegetable dehydration. J. Sci. Food & Agr. 12(6): 490-492. June 1961. 382 So12

Strips of potato and carrot were used in the investigation. Some were scalded and some were not scalded prior to being freeze-dried. Contrasting results were obtained with scalded and unscalded foods with regard to behavior of glucose.

115. DUCKWORTH, R. B. Diffusion of solutes in dehydrated vegetables. In Hawthorn, J., and Leitch, J. M., ed. Recent advances in food science, v. 2, p. 46-49, illus. Ref. London, Butterworths, 1962. 389.9 H31

Freeze-drying was one of the techniques used in various studies here.

116. DUCKWORTH, R. B., and TOBASNICK, M. Diffusion of sulphite during vegetable dehydration. J. Sci. Food & Agr. 11(4):226-228. Apr.1960. 382 So12

Samples of scalded and dried potato, carrot, and cabbage were used in the study. Freeze-dried carrot was used as a check on the efficacy of one of the methods used in preparing the material for autoradiography.

117. DUNOYER, J. M. New experiments in lyophilisation. (Sum.) Natl. Symp. Vacuum Technol. Trans. 8:83-84. 1961. Libr. Cong.

In English, French, and German.

Describes experiments in freeze-drying done in a current of cold and perfectly dry gas, rather than under a vacuum.

118. DUPAIGNE, P. Dessiccation des jus de fruits par lyophilisation [Dehydration of fruit juices by lyophilization]. Fruits 11(1):25-30, illus. Jan.1956. 80 F9492

119. EBBS, J. C. New food products and processes. Amer. Dietet. Assoc. J. 34(2):129-132, illus. Feb.1958. 389.8 Am34

Discussion of developments by the military includes section on freeze-drying. Its success in dehydration of meats, fish, poultry, and vegetables is pointed out. Reference is made to freeze-dried rations, used successfully by Antarctic explorers in the International Geophysical Year.

120. EBBS, J. C. New horizons for food. Amer. Dietet. Assoc. J. 39(2): 101-104. Ref. Aug.1961. 389.8 Am34

One section on freeze dehydration surveys briefly the technique, its costliness, and advantageous characteristics of the resulting product.

121. EDE, A. J. Effect of shape of operating chamber in the freeze-drying process. Nature [London] 159(4044): 610-611. May 3, 1947. 472 N21

Findings showed that efficiency is definitely affected by the design of the space in which freeze-drying takes place. The investigation was carried on at the Low Temperature Research Station, Cambridge, in connection with its research program on the application of freeze-drying to foodstuffs.

122. EDE, A. J. The low-temperature vacuum drying process as applied to green peas. II. J. Soc. Chem. Indus. 68(12):336-340. Dec.1949. 382 M31

Experimental study to determine the effects of vapor pressure, drying conditions, thickness of layer on the quality of processed peas.

123. EDE, A. J. Physics of the low-temperature vacuum drying process. I. J. Soc. Chem. Indus. 68(11):330-332. Nov.1949. 382 M31

Covers experiments and observations on such aspects as air pressure, rate of drying, vapor pressure, design of evaporator and condenser.

124. *85,000 pounds of fresh asparagus move thru FMC pilot production facility. Food & Drug Packaging 4(5):11. Mar. 2, 1961. 280.38 F733

125. EMBLIK, E. Die Gefriertrocknung von Fleisch und anderen Lebensmitteln [The freeze-drying of meat and other foods]. Schlacht.- u. Viehhof-Ztg. 61(10):333-335. Ref. Oct.1961. 286.85 D48

Includes discussion of the general principles of freeze-drying, its techniques, as well as advantages and disadvantages of the process. Summary in French at end (under title: La cryodessication des denrees alimentaires).

126. ENFIELD, J. Nuevos viveres para una nueva era [New provisions for a new era]. Annona 3(35):17-19, illus. Nov. 1958. 281.8 An73

Centers around discussion of superior quality of dehydrated foods produced in Aberdeen Experimental Station.

127. ERECTS freeze-dry plants next to freezing facility. Food Engin. 34(9): 73. Sept.1962. 389.8 F737

Lists three advantages in such an arrangement.

128, EUREKA! Food in a flash: freeze drying is the most important innovation in food preservation since the tin can. J. Amer. Ins. 38(4):1-4, illus. Apr. 1962. Libr. Cong.

Reviews the variety of food items available, current and potential market outlets, and firms at present experimenting with freeze-dehydration. Includes advantages of the new process and its problems.

129. EVSTRAT'EVA, E., KURYACH'EV, A., and SINITSYN, A. Konservirovanie tvoroga metodom sublimatsionnoi sushki [Preservation of quarg by freeze-drying]. Moloch. Promysh. 20(8):7-10, illus. Aug.1959. Libr. Cong.

Describes details of experiments investigating possibility of preserving seasonal surpluses by freeze-drying process.

Abstract in Dairy Sci. Abs. 22(1): 20. Jan.1960. 241 Im76

130. EXPERIMENTAL dehydrated steaks and chops. Res. & Devlpmt. Food & Container Inst. Activ. Rpt. 7(1):5-6. Apr.1955. 389.9 As74A

Freeze-drying procedures used to process these meats were developed as a result of cooperative laboratory and pilot plant work of industry and research institutions in conjunction with studies at the Quartermaster Food and Container Institute. The possibility of using this process commercially is being studied.

*Not examined

131. EXPERTS see freeze-drying, dehydrofreezing as augment to FF industry, not successor. Frozen Food Age 10(3): 11. Oct.1961. 389.8 F934

Brief survey covering impact, problems, and potential of these new processes.

132. FMC FREEZE-drying equipment. Food Trade Rev. 31(12):61, illus. Dec. 1961. 389.8 F7334.

Describes large commercial-scale equipment designed to produce high quality foods at low cost.

133. FMC'S freeze-drying facility demonstrates application of new process. Canning Trade 83(25):57, illus. Jan. 2, 1961. 286.83 T67

Food Machinery and Chemical Corporation, San Jose, Calif., has built a freeze-drying facility for use in demonstrating its equipment to potential food-processing customers. Included here is a discussion of how it works.

134. FARKAS, D. F., and GOLDBLITH, S. A. Studies on the kinetics of the lipozidase inactivation using thermal and ionizing energy. J. Food Sci. 27(3):262-276. Ref. May/June 1962. 389.8 F7322

The investigation attempted to discover the combined effects that cause deterioration in some foods. Lyophilized soybean lipozidase was used in the study.

135. FEEDING systems of the future. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 9(2):77-91, illus. June 1957. 389.9 As74A

The proposed military subsistence represented by current research is given in practical terms through a description of projected, plausible military situations. Freeze-dried foods play an important role in these meals.

136. FEEDING systems to meet new tactical needs. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 11(4):227-236, illus. Dec.1959. 389.9 As74A

Describes the part that freeze-dried foods, along with other dehydrated items, will play in future military rations.

137. FILM packaging for AFD foods. Food Trade Rev. 31(12):64-65. Dec. 1961. 389.8 F7334

Discusses possibilities of different materials. Points out types of protection required, including reference also to self-service merchandising and automatic vending. Considerable research is being carried on to solve specific problems for manufacturers and packers.

138. THE FIRST commercial A. F. D. plant. Food Processing & Packaging 30(358):245-249, illus. July 1961. 389.8 F738

Detailed description of equipment and operation of the factory built by the Irish Sugar Company, which has begun full-scale production of freeze-dried foods.

139. FISHER, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 237 p. Ref. 389.9 F53

Individual articles are cited under respective authors.

140. FLEXIBLE packaging for freeze-dried foods featured in fall conference program. Amer. Egg & Poultry Rev. 23(8):34. Aug.1961. 47.8 Am38

A preview of topics to be covered in the September 1961 Military-Industry Conference sponsored by the Research and Development Associates. In addition to presentation of latest developments in freeze-drying, new emphasis will be placed on packaging achievements, problems, and needs.

141. FLEXIBLE packaging materials for AFD foods. Food Trade Rev. 31(11):45. Nov.1961. 389.8 F7334

Discusses use of aluminum foil and foil laminates, pointing out advantages here. Includes table of recommended specifications for unprotected blocks, for unprotected pouches, and for pouches protected by a carton. Cautions that many foods will require special packaging attention.

142. FLOSDORF, E. W. Advances in drying by sublimation: blood plasma, penicillin, foods. J. Chem. Educ. 22(10):470-480, illus. Ref. Oct. 1945. 381 J826

Includes a discussion of its objectives, basic principles, applications and uses, chemical changes, and type of equipment used. Points out that a wide variety of foods may be preserved successfully by this new process.

143. FLOSDORF, E. W. Drying by sublimation. Food Indust. 17(1):92-95, 168,170,172,174,176,178, illus. Jan. 1945. 389.8 F737

Detailed discussion of theory and practice, including favorable characteristics, equipment details, production costs, packaging, and general outlook.

144. FLOSDORF, E. W. Drying meat by sublimation. Meat 22(5):27-28,58-59, illus. Apr.1945. 286.85 M464

Describes the basic details of the process, cost of drying, and characteristics of the resulting food product, with specific reference to flavor, storage, vitamin, and chemical components.

145. FLOSDORF, E. W. Freeze-dried foods: what they are - how they are prepared. Frosted Food Field 24(6): 15-16, illus. June 1957. 389.8 F922

Advantages of freeze-dried foods are listed, marketing outlook is discussed, as well as the necessity for judgment in selecting foodstuffs to be processed.

146. FLOSDORF, E. W. Freeze-drying (drying by sublimation). New York, Reinhold, 1949. 280 p., illus. Ref. 295 F66

Contents: 1, Introduction; 2, Basic principles; 3, Applications [medical products; food products; industrial products]; 4, Changes in products during desiccation from the frozen state and in storage; 5, Equipment used for medical products; 6, Equipment for foods.

Author states in Preface that book brings together all published technical knowledge on the subject, as well as much that has not been written. Includes extensive bibliography (p. 258-272), which supplements bibliographies at ends of chapters. Material relative to foodstuffs, p. 117-130,218-228.

147. FLOSDORF, E. W. Freeze-drying as applied to penicillin, blood plasma, and orange juice. Chem. Engin. Prog. 43(7):343-348, illus. July 1947. 381 C4232

Gives detailed discussion of technique of freeze-drying in general, covering in detail such areas as: Stages of drying, problems of heating, removal of water vapor in vacuo, freezing before drying. Also discusses continuous vs. batch operations.

148. FLOSDORF, E. W. Preservation by freeze drying. Refrig. Engin. 62(3): 49-50,117. Mar.1954. 295.9 Am32J

Although primarily about biological materials, some reference is made to commercial application with a variety of food items. Outlines eight advantages of the process and describes the technique and equipment.

149. FLOSDORF, E. W. Sublimation - its packaging requirements. Mod. Packaging 19(3):133-135,164, illus. Nov.1945. 309.8 M72

Includes discussion of developments in packaging that have been proved satisfactory and those rejected. Emphasis here is on vapor-proof requirement. There is a section on foodstuffs which have good potential for freeze-drying: Orange juice, goat's milk, carrots, peas, oysters, clams, fish fillets, meats, berry juices, soups, cooked cereals, coffee, and milk.

150. FOOD by sublimation. Economist 199(6145):1034-1035. June 3, 1961. 286.8 Ec7

Very brief description of the main concepts involved in freeze-drying, including its uncertain prospects. Vickers has built for the Irish Sugar Company what is claimed to be the first commercial plant for accelerated freeze-drying of food.

151. FOOD defence research in the United Kingdom: 2. The Food Defence Research Organisation of the Ministry of Agriculture, Fisheries and Food. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 8(1):61-66, illus. Apr. 1956. 389.9 As74A

Gives background leading up to opening of Research Establishment and Experimental Factory in Aberdeen, Scotland. Summarizes briefly work done there, including development of freeze-drying.

152. *FOOD freeze-drying process. Engineer 212:369-370. Sept. 1, 1961. Not in Natl. Agr. Libr.

Describes processing of coffee powder in newly constructed plant.

Abstract in J. Sci. Food & Agr. 13(4):i-194. Apr.1962. 382 So12

153. FOOD Science and Technology Congress. I. Food Trade Rev. 32(11): 37-41. Nov.1962. 389.8 F7334

Abstracts of selected papers presented at the First International Congress of Food Science and Technology held in London in Sept.1962.

Individual papers are cited under respective authors.

154. FORREST, J. C. The accelerated freeze-drying process. In Hawthorn, J., and Leitch, J. M., ed. Recent advances in food science, v. 2, p. 3-31, illus. Ref. London, Butterworths, 1962. 389.9 H31

An overall discussion, covering equipment details, pretreatment required, drying and unloading techniques, and a description of the Mark I AFD prototype and its operation.

Costs, packaging, and product quality are all touched on, as well as suggestions for further work to be carried out. It is pointed out that the problems to be solved in ultimately effecting a satisfactory process are of an economic nature.

155. FORREST, J. C. Large-scale freeze-drying equipment for foodstuffs. Brit. Chem. Engin. 4(7):390-394, illus. Ref. July 1959. Libr. Cong.

Describes design of driers, including discussion of instrumentation, pretreatment of foodstuffs to be dehydrated, recent innovations in the process, and a consideration of experimental work on the value of radiant heat and high-frequency dielectric heating.

156. FREEZE-dried food. Time 69(20): 61. May 20, 1957. 280.8 T48

Raytheon Manufacturing Company reports on its experience freeze-drying such food items as shrimp, lobster tails, and strawberries. The basic principles of the process are briefly explained, together with a description of the resulting products and their merits. Still in the experimental stage, the process presents many problems yet to be solved, especially in packaging and storage. States that the military offers the most likely potential for marketing at present.

157. FREEZE-dried foods. Consum. Rpt. 27(7):338-339, illus. July 1962. 321.8 C762

An evaluation of the developments to date, with specific reference to consumer tests of seven Armour products (scrambled eggs, pork chops, beefsteak, ham-patties, chicken stew were among these); judgment here based on prices, portions, preparation procedures, and palatability.

158. FREEZE-dried foods--a high priced bow. Investor's Reader 36(12): 17-20, illus. June 7, 1961. Libr. Cong.

Overall coverage of developments to date and future outlook. Discussion includes reference to the process itself, costs, description of the resulting food product, current and potential marketing outlets, advantages and drawbacks. Current activity in freeze-drying by many United States food firms, food machinery and equipment companies, is reviewed.

159. FREEZE dried foods have come to stay. Engineering 191(4963):756, illus. June 2, 1961. 290.8 En322

Description of equipment design and processing methods of accelerated freeze-drying installations, with special reference throughout to the newly opened Irish Sugar Company plant at Mallow.

*Not examined

160. FREEZE-dried meats and chicken. Food Trade Rev. 31(12):64. Dec.1961. 389.8 F7334

Discusses freeze-drying experience of Wilson and Company

161. FREEZE-dried shrimp. Food Trade Rev. 31(12):63, illus. Dec.1961. 389.8 F7334

Reviews experience of United Fruit Company in its processing operations. Marketing outlets at present consist primarily of institutions and the Armed Forces.

162. FREEZE-dries for world market. Food Engin. 33(7):37-39, illus. July 1961. 389.8 F737

The new full-scale freeze-drying plant of the Irish Sugar Company at Mallow is described. Its production covers meat, fish, fruit, and vegetables. Included in the discussion are brief financial and production data, as well as a more complete coverage of technical details of actual operation of the accelerated freeze-drying process itself. There is also a list of foods suitable for accelerated freeze-drying.

163. FREEZE-dry food line introduced by Armour. Food Field Rptr. 29(10):1,19, illus. May 22, 1961. 286.83 F73

This first group of Armour freeze-dry products, named Star Lite, will be distributed through mail-order outlets, sporting goods stores, and outdoor departments of department stores. They include steaks, pork chops, stews, ham-patties, and scrambled eggs. Later on, products with a different brand name will be marketed in grocery stores. Processing and packaging methods are described briefly.

164. FREEZE-dry: off and running. Food Business 9(11):33-35,39. Nov. 1961. 389.8 F7342

This progress report includes summary of estimates of current production by specific companies here and abroad, detailed table of freeze-dried food items in the military program, outlook for consumer acceptance, statistics regarding present and projected military market, and packaging problems.

165. FREEZE-dry whole mushrooms at Quebec plant. Food Canada 22(3):16-17, illus. Mar.1962. 389.8 F7323

Describes processing details, including custom-built equipment, in the first freeze-drier on the consumer market in Canada. Production to begin May 1962.

166. FREEZE-drying being widely demonstrated to food factories. Mod. Refrig. 64(762):919-920, illus. Sept.1961. 295.8 M72

Two new mobile units, a freeze-drier and a Cekatainer packager, are described.

167. FREEZE-drying gets hot. Indus. & Engin. Chem. 53(7):sup. 26A-27A, illus. July 1861. 381 J825

Overall cursory review of the new process: Its advantages, characteristics of resulting foodstuffs, pioneer companies in the field, available products to date, and costs.

168. FREEZE-drying improved with radar energy. Quick Frozen Foods 19(12):45, 156, illus. June 1957. 389.8 Q4

Still in the laboratory stage, the process has proved successful; and results of studies reviewed here indicate advantageous potential for use by military and industry.

169. FREEZE-drying of foods. Food Trade Rev. 31(11):33,42. Nov.1961. 389.8 F7334

Overall survey of current status of this new food preservation technique, including cursory report on highlights of the recent international two-day symposium at London, and giving indications of potential developments.

170. FREEZE-drying picks up pace; plan giant custom freeze-dry plant. Food Canada 22(3):18-19. Mar.1962. 389.8 F7323

Explores new problems connected with setting up operations, reviews successful applications of the process to date, and assesses overall economic aspects.

171. FREEZE drying takes first giant step. Quick Frozen Foods 23(11):43-45, illus. June 1961. 389.8 Q4

A look at the developments to date, both here and abroad; a critical evaluation of the process in general as well as in particular details; and an estimate of its future potential. Current marketing and consumption are discussed; some prices and costs are mentioned; successful and unsuccessful products are reviewed; myths concerning the process are exposed; and potential military usage is explained.

172. FREEZE-drying: the present outlook. Frosted Food Field 32(2):37,39-41,44-46, illus. Feb.1961. 389.8 F922

Reviews the development of freeze-drying in the United States from the first company using the process here on a food plant production line (Liana). Specific companies are discussed, together with their work, including products processed, costs, and equipment used. Advantages and disadvantages of the process, details of its techniques, market potential, and packaging are all covered.

173. FREEZING and refrigeration equipment. Food Mfr. 35(7):293-296,312, illus. July 1960. 389.8 F736

Describes design of accelerated freeze-drying equipment built by Vickers-Armstrongs, and discusses desirable forms of heating to be used in its operation.

174. FREEZING for freeze-drying. Food Engin. 34(9):73. Sept.1962. 389.8 F737

Considers the importance of manner of freezing a food item before it is freeze-dried; gives hints on freezing; and includes data on some specific effects that variations in freezing may have on quality of rehydrated foodstuff.

175. FRITZSCHE, H. W. Fruit and vegetable convenience food problems. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 11(3):169-170. Sept.1959. 389.9 As74A

It is noted that fruits require complete freeze-dry processing, whereas some vegetables, such as peas and corn, can be successfully dehydrated with only partial freeze-drying in combination with air-drying. More experimental work is necessary here to obtain satisfactory food items.

176. FRUIT and vegetable products. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 12(3):205-214. Sept. 1960. 389.9 As74A

Reviews different dehydration methods and equipment, together with main problems here with regard to fruits and vegetables. The bulk of the article is made up of detailed processing and packaging data for specific dehydrated items. Among the freeze-dried foodstuffs were: Whole kernel yellow corn, peas, spinach, fruit cocktail, and peaches.

177. FURGAL, H. P. Concentrated foods research. Armour & Co. Annu. Rpt. 1961:9-10, illus. 1962. 50.9 Ar5F

Reviews briefly: Reference to the current line of Star Lite freeze-dried food items; packaging problems requiring attention; plans for expansion of facilities; and continuous study of the process and equipment to lower costs and improve quality.

178. FURGAL, H. P. Freeze dehydration: fact and conjecture. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 10(2):91,94-95. June 1958. 389.9 As74A

Author believes that freeze-dried steaks and chops cannot compete successfully with fresh meat in civilian market. He makes suggestions on unique ways to utilize freeze-drying to make dehydration of meats a large industry.

179. FURGAL, H. P. Progress in meat dehydration. Food Engin. 26(9):74-76, 152, illus. Sept.1954. 389.8 F737

Discussion of freeze-drying as an innovation in food preservation techniques. Covers its processing details, advantageous features, development to date, and potential. Includes table showing relation of time, temperature, and vacuum to final moisture content of various meats.

180. FURTHER progress is made with A. F. -D. Frozen foods 14(9):611,614, 616, illus. Sept.1961. 295.8 Q4

Processing time has been shortened, a wide variety of foodstuffs have been successfully freeze-dried, and the first commercial accelerated freeze-drying plant has been put into operation by the Irish Sugar Company in Mallow. These developments are detailed here. In addition, reference is made to two mobile units now in service: One is for demonstration of the products, and the other for packaging them.

181. GALL, B. O. M., and LA PLANTE, R. A. Methods of application of microwave energy in industrial processes. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 133-146, illus. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

Discusses underlying principles, problems, and solutions. Brief explanations are included of the difficulties that can be expected with the five different methods reviewed. It concludes that the technique has great potential use.

182. GANE, R. The freeze-drying of foodstuffs. In Harris, R. J. C., ed. Biological applications of freezing and drying, p. 185-191. Ref. New York, Academic Press, 1954. 295 H24

After a preliminary reference to basic principles, the process itself, its advantages and disadvantages, the discussion centers around the three major features in a freeze-drying plant: The drying stages, heat transfer, and moisture removal methods.

183. GANE, R. Freeze-drying of foodstuffs. In Institute of Biology. Freezing and drying; report of a symposium held in June, 1951, p. 31-39, illus. London, 1951. 295.9 In72

Describes briefly studies with apple slices, infusions of tea, liquid egg, minced beef, and fish fillets.

184. GANE, R. Freezing, freeze-drying and freeze-concentration of foodstuffs. Research [London] 13(6): 207-211. Ref. June 1960. 472 R31

Describes technical aspects of three applications of refrigeration to food processing. It was pointed out that some vegetable tissues must be prefrozen and broken up before freeze-drying since water cannot evaporate fast enough to freeze them.

185. GANE, R. The water relations of some dried fruits, vegetables and plant products. J. Sci. Food & Agr. 1(2):42-46. Feb.1950. 382 So12

Various freeze-dried specimens of foodstuffs were included in the studies.

186. GAU, L. Die Bedeutung der Gefriertrocknung fur die Lebensmittelindustrie [The importance of freeze-drying for the food industry]. L und E 15(3):11-14. Mar.1962. 389.8 Z34

Discusses details of the process, including unique advantages of this method.

187. GEORGIA. AGRICULTURAL EXPERIMENT STATION. Foods for shelter storage; a literature review for the Office of Civil and Defense Mobilization, by J. G. Woodroof and O. K. Lebedeff. Experiment, 1959. 328 p. Ref. 241.64 G29

Survey of findings of various current investigations on freeze-drying of different meat, fish, fruit, and vegetable foodstuffs. Includes studies on storage stability, especially with regard to flavor, texture, color, and nutritive value.

Report consists of 735 literature abstracts and citations, and discussion of foods and containers for shelter storage. References to freeze-drying, p. 122, 128, 131-134, 144-145, 148.

188. GINNETTE, L. F., GRAHAM, R. P., and MORGAN, A. I. Freeze-drying rates. Natl. Symp. Vacuum Technol. Trans. 5:268-273, illus. 1958, pub. 1959. Libr. Cong.

Describes investigation with diced apples, diced carrots, and slabs of beef. Study attempted to determine freeze-drying rates of food items heated by conduction from a platen. Data are interpreted from engineering standpoint. Detailed attention is given to heat transfer and pressure. Several tables accompany article.

189. GINZBURG, A. S. Sushka pishchevykh produktov metodom sublimatsii [Drying of foodstuffs by sublimation method]. USSR. Ministerstvo Promyshlennykh i Prodovolstvennykh Tovarov. Nauchno-Tekhnicheskoe Izdatel'stvo. Sushka Pishchevykh Produktov [Drying of foodstuffs], p. 515-554,675-676, illus. Ref. 1960. Libr. Cong.

Technical discussion of equipment and processing technique.

190. GODFREY, O. D. Palatability and freshness preserved by new dehydrated food process. Austral. Food Mfr. & Distrib. 28(9):16,18, illus. Apr. 6, 1959. 389.8 Au7

The freeze-drying process, developed through years of investigation at the Research Establishment in Aberdeen, is considered a major breakthrough in food-preservation techniques. Its unique characteristics of retaining original texture and shape, of storage advantages, as well as its capability of being speedily prepared and served, point to a promising future market potential among housewives, institutions, explorers, and space travelers.

191. GOLDBLITH, S. A. Another revolution in foods. Technol. Rev. 64(6):29-30,50, illus. Apr.1962. Libr. Cong.

Traces stages of development of dehydration up to the latest technique and points out five reasons why freeze-dehydration is now economically and commercially feasible. The freeze-dried commercial products available now may be considered in three categories: Those that sell as such, components of soup mixes, and meals. Includes estimate of future volume of business in this new food field.

192. GOLDBLITH, S. A., KAREL, M., and LUSK, G. The role of food science & technology in the freeze dehydration of foods. Food Technol. 17(2):21-26; (3):22-24,27-28, illus. Ref. Feb.-Mar.1963. 389.8 F7398

Discusses in some detail the following groups of basic problems: Raw materials, physical and chemical changes in processing and storage (non-enzymatic browning, oxidative deterioration, changes in properties of food proteins, enzymatic deterioration), microbiological aspects, food engineering, and process parameters that affect food quality.

193. GOODING, E. G. B., and MACDOUGALL, D. B. The accelerated freeze-drying of potatoes. European Potato J. 4(1):69-73. Mar.1961. 75.8 Eu7

Describes new method of successfully freeze-drying potato chips, mashed potatoes, and meat-and-vegetable stew containing potatoes. Although authors do not foresee a widespread use of potatoes in future freeze-drying processing, they indicate that the development is worth watching.

194. GOODING, E. G. B., TUCKER, C. G., and MACDOUGALL, D. B. Dehydration of carrots. Food Mfr. 35(6):249-254. June 1960. 389.8 F736

Summary of results of experimental studies at Aberdeen. Freeze-dried carrots are discussed with regard to: Size of piece, drying process, compression, storage life, flavor, and reconstitution. Among unsolved problems reviewed here are the high cost of freeze-drying and the lack of uniformity of the accelerated freeze-dried product.

195. GOODING, E. G. B. La deshidratacion de alimentos por sublimacion [The freeze-drying of foods]. Inst. de Invest. Tecnol. Rev. 3(13):27-34. Oct. 30, 1961. 241.4 In73

Discussion covers a review of the characteristics of the processed foods, details of the process (including reference to accelerated freeze-drying), cost estimates, and a look at its possible interest to Colombia.

196. GOODING, E. G. B. Horticulture and dehydration. Sci. Hort. 14:110-115. 1959-60. 84 H78

Since freeze-drying has been developed almost to the point of commercial production, emphasis has now turned to providing good raw material for the dehydration process in order to insure a good product. The work here centers around investigation of potatoes, cabbage, carrots, beans, and peas.

197. GOODING, E. G. B. Quick-cooking dehydrated vegetables. Food Mfr. 32(11): 513-515. Nov. 1, 1957. 389.8 F736

Describes developments in accelerated freeze-drying of carrots, swedes, turnips, peas, broad beans, and green beans. The first three at present stage of development are satisfactory in soups, and the last three have produced very encouraging results.

198. GOODING, E. G. B., and ROLFE, E. J. Some recent work on dehydration in the United Kington. Food Technol. 11(6):302-306. Ref. June 1957. 389.8 F7398

Includes brief review of some investigations on freeze-drying of meat and fish.

199. GOODING, E. G. B. The storage behaviour of dehydrated foods. In Hawthorn, J., and Leitch, J. M., ed. Recent advances in food science, v. 2, p. 22-28. Ref. London, Butterworths, 1962. 389.9 H31

Summarizes the data that have been gained to date with regard to oxidative and nonoxidative deterioration, and enzymic changes. A consideration of moisture, sugar, and sulphur dioxide content, and of methods of scalding is included. Some mention is made of techniques used for storage tests.

Reference to freeze-dried foods is made throughout the discussion.

200. GORESLINE, H. E. Dehydration: process and promise. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 9(4):273-280, illus. Jan.1958. 389.9 As74A

Freeze-drying is one of four methods of food dehydration now used in the Army program. General principles of this technique are described, and production costs are discussed.

201. GORESLINE, H. E. Planning today for horizons of tomorrow. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 13(2):52-60. June 1961. 389.9 As74A

Freeze-dried foods have proved to be highly satisfactory for military feeding needs of the future. Many accompanying problems, however, must yet be resolved, especially with regard to storage stability and packaging of dehydrated foods.

202. GORESLINE, H. E. Some potentials of freeze-dehydrated foods. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 13(1):5-9. Mar.1961. 389.9 As74A

General principles of this new food preservation method are reviewed, and advantages of processed foodstuffs are discussed. Ways in which the frozen food industry members can become partners in the processing are pointed out. Specific problems connected with freeze-drying of fruits and vegetables are covered.

203. GORLING, P., and HEISS, H. R. Changes in dried vegetables during storage and how to avoid them. (Abs.) Food Trade Rev. 32(11):38. Nov.1962. 389.8 F7334

Refers to investigations carried out comparing freeze-dried and air-dried vegetables to determine superiority. In all cases studied here the freeze-dried items had excellent shape, swelling ability, and (with one exception--carrots) good color retention. Freeze-drying provided better quality than air-drying with spinach, asparagus, peas, leeks, mushrooms, brussels sprouts, and redpepper. However, there is greater susceptibility to oxygen in some freeze-dried foods than air-dried (e.g. carrots, spinach, parsley, and redpepper).

204. GORLING, P. Orientierende Versuche uber die qualitativen Vorteile der Gefriertrocknung von Gemusen [Directed research on the qualitative advantages of freeze-drying of vegetables]. Indus. Obst- u. Gemuseverwert. 47(3):60-62. Feb. 1, 1962. 389.8 K832

Covers carrots, spinach, leeks, cabbage, asparagus, parsley, and peas. Comparison made between results of freeze-drying and air-drying.

205. GORLING, P. Der wissenschaftliche und technische Stand der Gefriertrocknung von Lebensmitteln [Scientific and technical status of freeze-drying of foods]. Z. f. Lebensmtl. -Untersuch. u. -Forsch. 114(2):128-139. Ref. Feb. 6, 1961. 384 Z39

Includes physical background,

technical processing, and new findings about freeze-drying of meat, fish, fruits, and vegetables.

206. GOULDEN, J. D. S. Infra-red spectroscopy of dairy products. J. Sci. Food & Agr. 7(9):609-613, illus. Sept.1956. 382 So12

Freeze-dried milk was used in the course of the study.

207. GRAF, R. L. Industrial preparedness measures and their application to dehydrated foods. Res. & Devlpmt. Assoc. Food & Cont. Inst. Activ. Rpt. 10(4):251-255. Dec.1958. 389.9 As74A

Military looks to industry for production of products suitable for the Armed Forces. Outlines, step by step, the specific directions that developments must take. Includes also three general types of studies necessary: Exploratory, preparedness, and production.

208. GRAF, R. L. Present status of freeze-dried foods for the military. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 13(4):181-185. Dec. 1961. 389.9 As74A

Includes a discussion of potential military needs, plans for methods of introducing new food items, and a full-page table listing all freeze-dried food items in the procurement instrument release forecast. Continuing developmental research in this area is envisioned to solve current problems.

209. GRAU, R. Gefriertrocknungstagung [Freeze-drying conference]. Fleischwirtschaft 14(4):310-312. Apr.1962. 280.38 F62

Abstracts of various papers presented at the Fifth Freeze-Drying Conference, held Feb.27-28, 1962. at Cologne. Includes reports by the following: H. Ehlers, H. F. T. Meffert, G. Nemitz, L. R. Rey, C. P. Huysmans, J. Veldstra, R. von Sengbusch, and J. C. M. Meijer.

210. GT. BRIT. FOOD INVESTIGATION BOARD. Report, 1953. London, 1954. 56 p. 389.9 G792R

Reference to freeze-drying, p. 22-23. Studies with freeze-dried minced, cooked pork were made to investigate browning reaction.

211. GT. BRIT. FOOD INVESTIGATION BOARD. Report, 1954. London, 1955. 72 p. 389.9 G792R

Reference to freeze-drying, p. 11, 43,46.

Brief review of current investigations of freeze-drying at Aberdeen Experimental Factory; observations on freeze-drying of cod, with regard to moisture content and browning; and reference to studies centering on protein change and reconstitution of freeze-dried fish.

212. GT. BRIT. FOOD INVESTIGATION BOARD. Report, 1956. London, 1957. 68 p. 389.9 G792R

Reference to freeze-drying, p. 18-19.

A small freeze-drying plant capable of holding 33 pounds of fish has been constructed. Studies made here on reconstitution with freeze-dried fish show the texture and flavor to be superior to other forms of dehydrated fish. Other observations on freeze-dried cod are reported.

213. GT. BRIT. FOOD INVESTIGATION BOARD. Report, 1957. London, 1958. 81 p. 389.9 G792R

Reference to freeze-drying, p. 18-20.

Work with freeze-dried cod steaks and cod fillets is reviewed. Emphasis here centers on rate of heat transfer during processing, and changes in texture, taste, tenderness, and color during storage.

214. GT. BRIT. MINISTRY OF AGRICULTURE, FISHERIES AND FOOD. The accelerated freeze-drying (AFD) method of food preservation. London, 1961. 169 p., illus. Ref. 389.3 G797A

Contents: Ch. 1, Introduction; Ch. 2, Theoretical considerations; Ch. 3, Development of specifications; Ch. 4, The Mark I prototype AFD plant; Ch. 5, The drying operation; Ch. 6, Packaging; Ch. 7, Economics of the process; Ch. 8, Possible future developments; Ch. 9, Choice of raw materials; Ch. 10, Preparation of foodstuffs for drying; Ch. 11, Storage behaviour of dehydrated

foods; Ch. 12, Reconstitution and cooking; Ch. 13, Nutritive value; Ch. 14, Quality control.

Covers work carried on between 1955 and 1960 by the Research Establishment and Experimental Factory of the Ministry of Agriculture, Fisheries and Food, Aberdeen, Scotland.

215. GREAVES, R. I. N. The application of heat to freeze-drying systems. N. Y. Acad. Sci. Ann. 85(2):682-688, illus. 1960. 500 N484

Experiments using twenty percent coffee extract, and blood plasma were carried out to demonstrate the soundness of a theory about the high rate of drying (through the use of radiant heat combined with continous removal of dried material).

216. GREAVES, R. I. N. Minimizing product damage when drying biological solutions. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 13-16. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

The study was made to investigate the possibility of improving the economic efficiency of a commercial freeze-drying plant producing coffee extract without lessening its quality. Radiant heating is discussed.

217. GROOT, G. J. DE. De invloed van het afschrijvingsverloop op de droogkosten van groenten in een vacuum (vries) drooginstallatie [Influence of the course of depreciation on the cost of drying of vegetables in a vacuum (freeze) drying installation]. Netherlands. Dir. van de Tuinbouw. Afd. Tuinbouw- Econ. Aangelegenheden. Tuinbouw-Econ. Ber. 6(3):18-22. July 1960. 86 N385E

Includes two tables outlining costs.

218. GROSCHNER, E., HAMANN, O., and SCHARNBECK, M. Freeze-drying a modern preservation method for highly perishable foods. Internatl. Cong. Refrig. Proc. 10(3):39-43. 1959, pub. 1960. 295.9 In82

Results of tests on vacuum freeze-drying of foods. Touches on such details as pretreatment, heating, size of pieces, packaging, and storage.

219. A GROUND-swell for the 'drys'. Food Business 8(10):16-17. Oct.1960, illus. 389.8 F7342

The favorable factors gradually coming to light about the freeze-drying process have increased active interest in it among leading food companies. Current freeze-drying activities of several of these companies in the United States are reviewed briefly here; one of these is expected to put a line of about 40 freeze-dried meat items on the market shortly.

220. GUILBOT, A. Application de la cryodessiccation aux aliments [Application of freeze-drying to foodstuffs]. Aliment. et la Vie 45(10/12):243-254. Ref. 1957. 389.9 So1B

Survey of studies reflecting development to date includes: Basic introductory data, historical background, technical aspects (including freezing, drying, and heat transfer techniques, and equipment), main results obtained in laboratory or semi-industrial plants (regarding meat, fish, seafood, eggs, milk, bread, vegetables, fruit juice and beverages), characteristics of products, storage stability, application of process to various food industries (fish, eggs, milk, bread, vegetables, fruit, fruit juice, and beverages), nutritional information, and general outlook.

221. *GUILBOT, A. Suseni potravin sublimaci ledu za zmrazencho stavu; dnesni moznosti a meze pouziti [Exsiccation of food articles by means of sublimation of ice during the frozen state (cry-exsiccation): present day possibilities and limits of application] Prumysl Potravin 10(6):300-301. 1959. Not in Natl. Agr. Libr.

222. HAAS, H. Theoretische Betrachtungen zur Gefriertrocknung [Theoretical observations on freeze-drying]. Fette, Seifen Anstrichmtl. 61(11): 1151-1155. Nov.1959. 384 C422

English summary.

Consideration is given throughout to industrial application. Reference is made to food in the course of the discussion. Accompanied by examples

*Not examined

and graphic illustrations.

223. HACKENBERG, U. Gesichtspunkte fur die Planung industrieller Gefriertrocknungs anlagen [Suggestion for planning industrial freeze-drying plants]. (Abs.) Kalte 15(4):205. Apr.1962. 295.8 K122
Presented at the Fifth Freeze-Drying Conference at Cologne, Feb.1962.

224. HACKENBERG, U., and OETJEN, G. W. Heat transfer and temperature control for the "CQC" freeze-drying process. (Sum.) Natl. Symp. Vacuum Technol. Trans. 8:86-87. 1961. Libr. Cong.
In English, French, and German.
Measured heat transfer with different freeze-dried foodstuffs, varying the water vapor pressure.

225. HACKENBERG, U. Lebensmittelkonservierung durch Gefriertrocknung [Food conservation by freeze-drying]. Umschau 61(14):428-431. July 15, 1961. 474 Um7
Description, with diagrams, of plant for freeze-drying. Among foods to be processed by freeze-drying in Europe, it refers to soups (with meat and vegetables), and in the United States, to camping needs and steaks.

226. HAMDY, M. K. Ion-protein interrelations affecting the quality of dehydrated meat. U. S. Off. Tech. Serv. PB 145764, 37 p. 1958. 157.8 R29

227. HAMDY, M. K., and DEATHERAGE, F. E. Observations on the changes produced in the freeze dehydration of meat. (Abs.) Food Technol. 12(4, sup.):49. Apr. 1958. 389.8 F7398
Compares, with regard to water-holding capacity and eating quality, fresh beef and freeze-dehydrated meat.

228. HAMDY, M. K., CAHILL, V. R., and DEATHERAGE, F. E. Some observations on the modification of freeze dehydrated meat. Food Res. 24(1):79-90. Ref. Jan./Feb.1959. 389.8 F7322
Detailed study of the relationship between post-mortem aging and of cooking prior to freeze-dehydration, on the one hand, and eating quality of the meat, on the other. The investigation was directed toward achieving freeze-dehydrated meat of improved texture and tenderness upon cooked reconstitution.

229. HAMDY, M. M. Compression of dehydrated foods; review of literature. U. S. Qmaster. Food & Container Inst. Armed Forces. Libr. B. 5, 27 p. May 1961. 152.7 L612
Reference to freeze-dried vegetables, p. 16, 17, 23.

230. HAMM, R., and DEATHERAGE, F. E. Changes in hydration and changes of muscle proteins, during freeze-dehydration of meat. Food Res. 25(5):573-586. Ref. Sept./Oct.1960. 389.8 F7322
The study investigated the undesirable water-holding characteristics of some freeze dehydrated meat. It was determined that the freezing process itself was not the cause of the undesirable changes in meat during freeze-drying.
Abstract in Frosted Food Field 32(2): 62. Feb.1961. 389.8 F922

231. HAMM, R. Chemische und physikalische Veranderungen bei der Gefriertrocknung von Fleisch [Chemical and physical changes with freeze-drying of meat]. (Abs.) Kalte 15(4):202. Apr. 1962. 295.8 K122
Paper presented at the Fifth Freeze-Drying Conference in Cologne, Feb.1962.

232. HAMM, R. Einfluss der Gefriertrocknung auf die Wechselwirkung zwischen anorganischen Ionen und Proteonen des Fleisches [Influence of freeze-drying on the interrelation between anorganic ions and proteins of meat]. Fleischwirtschaft 14(3):204-206. Ref. Mar.1962. 280.38 F62
English summary.
Abstract in Food Manuf. 37(9):422. Sept.1962. 389.8 F736

233. HAMM, R. Freeze dehydration. In Chichester, C. O., Mrak, E. M., and Stewart, G. F., ed. Advances in food research, v. 10, p. 411-413. New York, Academic Press, 1960. 389 M87
A review of the findings of various investigations made on biochemical changes accompanying both the dehydration and rehydration processes.

234. HAND, D. B., MOYER, J. C., and WAGENKNECHT, A. C. Effect of drying conditions on moisture retention and density of dehydrated peas. Food Technol. 9(5):219-222. May 1955. 389.8 F7398

Various combinations of two drying procedures were used to assess the factors limiting low moisture content attainment in dehydrated peas. Conventional air-dryer and vacuum-drying with a Stokes cabinet type freeze-drying unit were used. The findings suggested that a combination of drying methods (yet to be determined) will probably be necessary to produce best results.

235. HANSON, S. W. F. Accelerated freeze-drying of food. Food [London] 28(334):245-248, illus. July 1959. 389.8 F738

Describes results of early attempts and later developments in the use of accelerated freeze-drying method with steaks and cod. Equipment, techniques used, and results obtained are discussed.

236. HANSON, S. W. F. Accelerated freeze-drying of food. Gt. Brit. Min. Agr., Fisheries & Food. Agr. 68(9):499-500. Dec.1961. 10 G79J

A cursory review of the various processes of food preservation--canning, freezing, dehydration--leading up to freeze-drying. The advantages of this latest process are enumerated and trends indicated.

237. HANSON, S. W. F. Advances in vacuum dehydration in the United Kingdom. Food Technol. 12(4):194-195. Apr.1958. 389.8 F7398

Traces briefly the gradual improvements in freeze-drying equipment and techniques at the Experimental Factory in Aberdeen during the previous six years. With the latest developments it is now possible to freeze-dry, producing higher quality in less time and on a larger and more commercially attractive scale than before.

238. HANSON, S. W. F. Future work on dehydration; informal discussion meeting at Torry. Chem. & Indus. 26:825-826. June 28, 1958. 382 M31C

Participants here from the United States, Canada, Germany, Switzerland, and the Netherlands, represented industrial, government, and university interests. Discussion centered on problems which need further investigation; freeze-drying was considered here in the interchange centering on rehydration, oxidative deterioration, and flavor.

239. HANSON, S. W. F. The maintenance of life in space ships. III. The food problem. In Institute of Biology. The biology of space travel, p. 33-41. London, 1961. Libr. Cong.

Discussion includes reference to the many characteristics of freeze-dried foods which make them ideal for meals in spaceships. Article also deals with possible ways of solving water problem on extended flights.

240. HANSON, S. W. F. Some observations on the problem of space feeding. Food Technol. 12(9):430-432. Sept.1958. 389.8 F7398

Points out that freeze-dried foods possess all the necessary requirements to serve in future space flights: prime nutrient quality, attractive appearance and flavor, and variety of serving.

241. HAPPOLD, F. H. New foods in a vacuum. Statist. 176(4397):814-815, illus. June 15, 1962. 286.8 St2

Concerned primarily with the disadvantageous features of accelerated freeze-drying technique and obstacles to be overcome. It lists the firms currently working on this new food process in Europe as well as in the United States.

242. A HARD look at freeze drying. Quick Frozen Foods 23(9):210. Apr. 1961. 389.8 Q4

Explains difference between freeze-drying and dehydrofreezing, evaluates published article on freeze-drying, and presents brief picture of general potential and limitations of the new process.

243. 'HARDWARE' is now ready for freeze-drying of meats. Natl. Provisioner 143(23):14-16,35-36, illus. Dec. 3, 1960. 286.85 N21

Detailed descriptions of equipment of freeze-drying plants by various representatives of American and foreign meat packing firms. Systems are compared, engineering data and cost estimates are included, and capacities are outlined. One firm has already installed continuous dehydrators for tea, coffee, and orange juice, and considers continuous freeze-drying practical from an engineering standpoint. Current research, including latest developments in package sealing, is noted.

244. HARPER, J. C., and CHICHESTER, C. O. Freeze drying--application of dielectric heating. In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p. 11-14. Chicago, 1961? 389.3 R31

Analyzes drying process, noting that a major factor limiting freeze-drying (namely, heat transfer rate) may be overcome through the use of dielectric heating. Discusses problems in application of this method.

245. HARPER, J. C., and TAPPEL, A. L. Freeze-drying of food products. In Mrak, E. M., and Stewart, G. F., ed. Advances in food research, v. 7, p. 171-234. Ref. New York, Academic Press, 1957. 389 M87

Covers: Methods and equipment; fundamentals of the drying process; application of freeze-drying to foods; and additional research needs.

246. HARPER, J. C., CHICHESTER, C. O., and ROBERTS, T. E. Freeze-drying of foods. Agr. Engin. 43(2):78-81,90, illus. Ref. Feb.1962. 58.8 Ag83

A discussion of the problems involved in designing a pilot scale freeze-drier using dielectric heating, followed by a description of such a unit already constructed but not yet put in operation.

247. HARRIS, R. J. C., ed. Biological applications of freezing and drying. New York, Academic Press, 1954. 415 p. 295 H24

Part pertaining to freeze-drying of foods is cited under individual author.

248. HARTENECK, G. Das Verpacken gefriergetrockneter Lebensmittel [The packaging of freeze-dried foods (Literature report)]. Verpackungs-Rundschau 13(5):Insert 40-43. May 1962. 280.38 V592

Includes discussion of problems involved, various materials available, and reference to specific types of food items.

249. HAUGH, R. R., and MEHRLICH, F. P. The military looks at freeze dehydration economics and engineering. (Abs.) Food Technol. 14(4):Insert 27. Apr. 1960. 389.8 F7398

Includes discussion of such subjects as: Cost appraisals, plant engineering, systems factors, processing costs, transportation, and packaging costs applicable to geographical areas.

250. HAWTHORN, J., and LEITCH, J. M., ed. Recent advances in food science; papers read at the Residential Summer Course, Glasgow, September 1960. London, Butterworths, 1962. 2 v. 389.9 H31

Parts pertaining to freeze-drying of foods are cited under respective authors.

251. HEARNE, J. F. Methode de dessication acceleree par le froid pour la conservation des denrees alimentaires [Method of accelerated freeze-drying for the preservation of food products]. Fructidor 5:9; 7:9-10. Feb. 15 - Mar. 5, 1962. 286.83 F9423

Traces the development of dehydration and touches on principal aspects of this particular technique. Includes technological data about freezing and drying procedures, with special reference to specific fruits and vegetables. Reconstitution and cooking methods, costs, and future developments are discussed.

252. HEISIG, C. G., and KOBE, K. A. Selective melting of frozen solutions with radio-frequency power; dielectric heating gives new separation process for heat-sensitive materials. Indus. Engin. Chem. 50(10):1517-1524, illus. Ref. Oct.1958. 381 J825

A technical discussion of experimental studies centering on the process. Its characteristics are listed, and practical applications are included. One statement suggests that it could replace freeze-drying.

253. HENICK, A. S. Oxygen problem in dehydrated foods. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 13(4):200-209. Ref. Dec.1961. 389.9 As74A

Freeze-dehydrated items were used in experimental work carried on by the military. Areas studied were: Fat oxidation in model systems, enzyme catalysis of oxidative deterioration, and interaction of protein with breakdown products of lipid oxidation.

254. HERRMANN, K. Die Gefriertrocknung des Fleisches und anderer tierische Produkte [The freeze-drying of meat and other animal products]. Fleischwirtschaft 13(9):730-732, 735-736, illus. Ref. Sept.1961. 280.38 F62

Surveys the leading current research studies on meat, poultry, and fish, including investigations on biochemical changes during freeze-drying and subsequent storage, modifications in the process, and additional technological development problems. Shortening the drying period and improving equipment are cited as means toward reducing costs.

255. HILBERT, G. E. Inside Russia's food plants. Food Engin. 33(4):33-36. Apr.1961. 389.8 F737

A very brief mention of a freeze-drying pilot plant and the poor quality of the meat processed in it.

256. HINTON, H. R. Freeze-drying in the United Kingdom. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 10(3):182-187. Sept.1958. 389.9 As74A

The facilities and activities at the Research Establishment at Aberdeen are discussed. Accelerated freeze-drying procedures and production are detailed, including latest investigations. Work here on dehydrated fish, meat, fruit, and vegetables has produced hundreds of pounds of material at one time.

Also reprinted in Food Technol. Austral. 11(5):215,217,219,221,267. May 1959. 389.8 F7333

257. HINTON, H. R. Military usage of convenience foods in the United Kingdom. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 11(3):151-153. Sept. 1959. 389.9 As74A

Discusses by specific food item the results obtained at the Aberdeen factory with the accelerated freeze-drying process. Generally the results have been satisfactory and encouraging. In the course of the developmental work 145 expeditions, military and civilian, were supplied with dehydrated foods, including accelerated freeze-dried.

258. HINTON, H. R. Prepared foods for military use (British Army). Food Technol. 12(12):699-700. Dec.1958. 389.8 F7398

Describes accelerated freeze-drying activity being carried on in the Research Establishment in Aberdeen, Scotland. Includes discussion of food products successfully processed, packaging problems, and new developments.

259. HIRSCHMANN, D. J., and LIGHTBODY, H. D. Effect of bacteria on quality of stored lyophilized egg powders. Food Res. 12(5):381-392. Sept./Oct.1947. 389.8 F7322

Results of scientifically controlled investigation showed that lyophilized egg powders, inoculated with Pseudomonas fluorescens before drying, deteriorated during storage as a result of bacteria activity.

260. HORNSTEIN, I., CROWE, P. F., and SULZBACHER, W. L. Constituents of meat flavor: beef. J. Agr. Food Chem. 8(1):65-67. Ref. Jan./Feb.1960. 381 J8223

In the investigation a powder concentrate was obtained through lyophilization of a water extract from cooked beef; when heated, it was found to have

a flavor like cooked beef. Techniques used in the study are described.

261. HORNSTEIN, I., and CROWE, P F. Flavor studies on beef and pork. J. Agr. Food Chem. 8(6):494-498. Ref. Nov./Dec.1960. 381 J8223

Lyophilized cold water extracts of lean beef and lean pork were used in the investigation described here.

262. HORST, H. C. Films and laminates available for flexible packaging of freeze-dried and thermally processed foods. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 13(4):228-230. Dec.1961. 389.9 As74A

Impermeability to oxygen and water vapor transmission is the basic requirement of proper packaging here. Continuing research is being carried on to achieve the most functional and economical materials to achieve this.

263. HOW FREEZE-dried shrimp are produced. Food Processing 22(12):26-31, illus. Dec.1961. 389.8 F7325

A step-by-step review, accompanied by photo sequence, of complete process from hauling in the catch until drying operation is completed. Radiant heating is used. A chart showing typical data on drying time for six food items is included, as well as a descriptive insert about Wagerized shrimp.

264. HUGHES, N. Experiments in food dehydration. Progress 47(261):34-42, illus. Winter 1958-59. 280.8 P949

Freeze-drying is one of the methods of drying described in this consideration of the three basic techniques worked on at Aberdeen. Work at this factory centers around refining techniques and selecting best foods to take advantage of them.

265. HULSE, J. H. Dehydration: the commercial potentialities. Food Canada 20(7):28-29. July 1960. 389.8 F7323

Section on freeze-drying includes brief discussion of advantages and disadvantages of it, variations in drying methods, interest in it by North American and European food companies, proposed designs for commercial units, and estimated costs.

266. HULSE, J. H. Food defence research in Canada. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 12(2):64-71. June 1960. 389.9 As74A

With regard to freeze-drying, the article describes the unique process, laboratory studies on perfecting its techniques, on producing satisfactory foodstuffs, on rancidity factors, and storage problems, as well as packaging research.

267. HUNT, S. M. V., and MATHESON, N. A. Adenosine triphosphatase and contraction in dehydrated muscle fibres. Nature [London] 181(4607): 472-473, illus. Feb. 15, 1958. 472 N21

An investigation of changes in actomyosin to determine if it is a factor making dehydrated raw meat or fish tougher and less juicy after reconstitution. The beef and cod examined here were dehydrated either by freeze-drying in a vacuum desiccator or by vacuum contact-plate drying process.

268. HUNT, S. M. V., and MATHESON, N. A. The effects of dehydration on actomyosin in fish and beef muscle. Food Technol. 12(8):410-416, illus. Ref. Aug.1958. 389.8 F7398

An investigation of the changes that take place in actomyosin of beef and cod muscle when freeze-dried by vacuum contact-plate method. It was found that in the case of cod, actomyosin becomes unsoluble, loss of contractility of muscle fibers may or may not occur, and about half of the adenosine triphosphatase activity is not destroyed. Beef muscle fibers lost no contractility, and they, also, maintained about half of their triphosphatase activity.

269. HUNT, S. M. V., and MATHESON, N. A. The relationship between the quality of dehydrated raw beef and the adenosine triphosphatase activity after storage at various moisture contents. Food Res. 24(3):262-270. May/June 1959. 389.8 F7322

The tests were carried out with raw beef dried by the accelerated freeze-dry process. The results of the tests

are accompanied by discussion of their practical and theoretical implications.

270. IDEAS from the military [Quartermaster Corps tests tough carton for freeze-dried foods]. Mod. Packaging 35(2):130-132,230, illus. Oct.1961. 309.8 M72

One of recent food packaging developments is a bag-in-box providing three years protection; it consists of a flexible lamination of polyvinyl chloride, aluminum foil, and polyester. Other research on packaging materials and machines for freeze-dried foods is discussed.

271. INGLES, D. L., and REYNOLDS, T. M. Chemistry of non-enzymic browning. IV. Determination of amino acids and amino acid-deoxyfructoses in browned freeze-dried apricots. Austral. J. Chem. 11(4):575-580. Nov.1958. 475 Au73

The study was carried on by the Division of Food Preservation and Transport of the Commonwealth Scientific and Industrial Research Organization, Australia.

272. INGLES, D. L., and REYNOLDS, T. M. Chemistry of non-enzymic browning. IX. Studies of sugar mono-esters of malic acid found in browned freeze-dried apricots. Austral. J. Chem. 12(3): 483-490. Aug.1959. 475 Au73

The study was carried on by the Division of Food Preservation and Transport of the Commonwealth Scientific and Industrial Research Organization, Australia.

273. INGRAM, M. Freeze-drying of foodstuffs. Food Technol. 16(1):35-37,39-40. Jan.1962. 389.8 F7398

Detailed news report of the symposium at The Borough Polytechnic, London, Oct. 19 and 20, 1961. Consists of summaries of individual papers and of subsequent discussions on many phases of freeze-drying.

274. INSTITUTE OF BIOLOGY. Freezing and drying; report of a symposium held in June, 1951. London [1951]. 205 p. 295.9 In72

Parts pertaining to freeze-drying of foods are cited under respective authors.

275. INSTITUTE OF FOOD TECHNOLOGISTS. Food technology in the U. S. A. Food Trade Rev. 32(7):33-38. July 1962. 389.8 F7334

Report of I.F.T. convention. Abstracts of selected papers are included.

Individual reports are cited under respective authors.

276. IS FREEZE-drying warehousing boon? Quick Frozen Foods 23(9):165-166,168-169,171. Apr.1961. 389.8 Q4

Advice from the Refrigerated Research Foundation representatives to refrigerated warehousemen emphasizes that they should direct their research toward freeze-dried foods. In this way, they will demonstrate their potential for freezing and storing raw products before freeze-drying.

277. JACKSON, J. M. The increased application of food technology in the fast-moving food industry. Canner/Packer 131(10):105-106. Sept. 25, 1962. 286.83 C16

Reviews current and projected changes in the food industry; freeze-drying is referred to briefly and is reported to be the most spectacular development in dehydration procedures.

278. JACKSON, S., RICKTER, S. L., and CHICHESTER, C. O. Freeze-drying of fruit. Food Technol. 11(9):468-470, illus. Sept.1957. 389.8 F7398

Four methods of transferring heat to drying peaches were investigated (namely, single-plate, double plate, infrared, and dielectric). All drying tests were performed in the Stokes freeze-drier except those using dielectric heating. Results indicated that the dielectric work seemed the most promising for rapid lyophilization.

279. JAREMUS, B. M., KUEHNER, R. L., and SCHOLTEN, W. Submarine food storage project. (Abs.) U. S. Off. Tech. Serv. U. S. Govt. Res. Rpt. 36(10):99. Nov. 20, 1961. 157.8 B47

The investigation of present food preservation methods showed that freeze-drying will have an effect on chill, freeze, and dry stores distribution in near future.

280. JASON, A. C. Fundamental aspects of dehydration of foodstuffs; report on Aberdeen Conference, March 25-27, 1958. Chem. & Indus. 26:821-825. June 28, 1958. 382 M31C

A review of the twenty papers presented at the conference organized by the Food Group of the Society of Chemical Industry. Papers discussing the freeze-drying process dealt with the general behavior of freeze-drying and the new accelerated system.

281. JOHNSON, D. A., KURTZ, G. W., and KOCH, R. B. A study of physical and chemical changes in beef protein caused by lyophilization. (Abs.) Food Technol. 14(4):Insert 25. Apr.1960. 389.8 F7398

As a result of studying a hot water-soluble, non-dialyzable fraction of fresh and lyophilized beef, differences were found in the physical characteristics of the fraction investigated on lyophilization. These differences may partly account for texture changes in the lyophilization of beef.

282. JOHNSON, P. Dry soup battle bubbles; Campbell, Knorr challenge dominance of Lipton. Adver. Age 32(34): 3,88, illus. Aug. 21, 1961. 238.28 Ad94

Red Kettle is the brand name of new freeze-dried Campbell soups. Plans for introducing these on market-by-market basis are discussed.

283. JOHNSTON, F. B. Science and food processing. Agr. Inst. Rev. 17(2):15-17,25. Mar./Apr.1962. 7 Ag8

Includes a cursory review of freeze-drying process, its advantages, packaging, development to date, and general outlook.

284. JOKAY, L., and MEYER, R. I. Application of lyophilization to cheese products. II. The development of freeze-dehydrated creamed Cottage cheese. (Abs.) J. Dairy Sci. 42(5):908-909. May 1959. 44.8 J822

Details of experimental procedures and results are recorded briefly.

285. JOKAY, L., and MEYER, R. I. Development of a pre-cooked freeze-dehydrated scrambled-egg product for military use. (Abs.) Food Trade Rev. 31(6):57. June 1961. 389.8 F7334

Includes formula, cooking procedure, freezing and drying data, and description of processed product.

286. JONES, N. R. "Browning" reactions and the loss of free amino acid and sugar from lyophilized muscle extractives of fresh and chill-stored codling (Gadus callarias). Food Res. 24(6): 704-710. Ref. Nov./Dec.1959. 389.8 F7322

The investigation was conducted at the Torry Research Station in Aberdeen, Scotland to study the problems of deterioration during storage of dehydrated fish.

287. JONES, N. R. Browning reactions in dried fish products. In Hawthorne, J., and Leitch, J. M., ed. Recent advances in food science, v. 2, p. 74-80. Ref. London, Butterworths, 1962. 389.9 H31

Reviews recent developments in sugar-amino and other reactions in fish muscle with regard to dehydration of fish. Lyophilization was used in some of the studies discussed.

288. JONES, N. R. 'Browning' reactions in freeze-dried extractives from the skeletal muscle of codling (Gadus callarias). Nature [London] 174(4430): 605-606. Sept. 25, 1954. 472 N21

The effect of water relations, of temperature, and of pH were investigated.

289. JONES, N. R. Discoloration of muscle preparations from codling (Gadus callarius) by degradation products of i-methylhistidine. Nature [London] 177(4512):748-749. Apr. 21, 1956. 472 N21

Freeze-dried preparations were used in this study.

290. JONES, N. R. The free amino acids of fish. Biochem. J. 60(1):81-87. Ref. May 1955. 382 B52

Freeze-dried extracts were used throughout the study.

291. JONES, N. R. The free amino-acids of fish. I. Taurine in the skeletal muscle of codling (Gadus callarias). J. Sci. Food & Agr. 6(1):

3-9, illus. Ref. Jan.1955. 382 So12
Freeze-drying was used in the course of the experimental study.

292. JONES, N. R. The free amino-acids of fish. II. Fresh skeletal muscle from lemon sole (Pleuronectes microcephalus). J. Sci. Food & Agr. 10(5):282-286. May 1959. 382 So12
Freeze-dried portions were used in the experimental study which was carried on during the period from Apr. 1953 to Oct. 1956.

293. JONES, N. R. Free sugars in chill-stored, trawled codling (Gadus callarias) muscle. J. Sci. Food & Agr. 9(10):672-677. Ref. Oct.1958. 382 So12
Lyophilized extracts were used in the investigation. Discusses causes of changes in glucose and ribose and their relationship to browning in salted and dehydrated codling.

294. JONES, N. R. Kinetics of phosphate-buffered, ribose-amino reactions at 40° and 70% relative humidity: systems related to the "browning" of dehydrated and salt cod. J. Sci. Food & Agr. 10(11):615-624. Ref. Nov.1959. 382 So12
Lyophilized mixtures were examined in the experimental studies.

295. JOSLIN, R. P., and PROCTOR, B. E. Some factors affecting the whipping characteristics of dried whole egg powders. Food Technol. 8(3):150-154, illus. Ref. Mar.1954. 389.8 F7398
Various combinations of freeze-dried and fresh whole eggs, egg whites, and yolks were used in these studies.

296. JOYCE, A. E., ROLLEY, H. L. J., and SELF, R. An all-glass experimental freeze-drying unit for research on fruit juices and pulps. Food Trade Rev. 31(1):37-38, illus. Jan.1961. 389.8 F7334
Detailed description with three illustrations.

297. JOYCE, A. E. Quality in soft fruit. Sci. Hort. 14:116-125. 1959-1960. 84 H78
The study was undertaken as a result of successful freeze-drying of a wide range of soft and top fruits. Since it was found that the chief characteristic change in dehydration processing was in flavor, it was decided to try to discover on what characteristics fruit quality depends.
Only the introductory paragraph refers directly to freeze-drying.

298. KAN, B. Methods of determining freeze-drying process end points. In Fisher, F. R., ed. Freeze drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 163-177, illus. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53
The four methods presented are not proved procedures, but suggestions of likely directions for further exploration.

299. KARMAS, E., THOMPSON, J. E., and PERYAM, D. B. Thiamine retention in freeze-dehydrated irradiated pork. Food Technol. 16(3):107-108. Mar.1962. 389.8 F7398
The investigation was undertaken to determine whether the usual high loss of thiamine in irradiated meats may be lessened if they are freeze-dehydrated before irradiation. Among the results it was indicated that thiamine retention in pork is increased if meat is dehydrated before being irradiated.

300. KELLY, J. M., NEWCOMER, J. L., and BORSENIK, F. Freeze-dried whole egg solids, other processed eggs and fresh eggs. Amer. Dietet. Assoc. J. 40(1):31-34. Jan.1962. 389.8 Am34
A comparative study of flavor preferences; frozen, spray-dried, freeze-dried, and fresh eggs were included. Baked custards were used as the test medium because of the importance of eggs in their composition and of their sensitivity to the quality and properties of eggs. Results of responses of consumer preference panel are reviewed.

301. KHAKHINA, L. P. Myaso sublimatsionnoi sushki i ego primenenie dlya izgotovleniya pishchevykh kontsentratov [Freeze-dehydrated meat and its use for manufacturing of food concentrates]. Voprosy Pitaniia 16(5):87-89. 1957. 389.8 V89

English summary.

Compares fresh, heat-dried and freeze-dried meat, pointing out quality and prolonged storage stability of latter.

Freeze-dried meat can be stored successfully for two years if packing is oxygen-tight (and stored in vacuum). Rehydrated meat absorbs 80 to 85 percent of the original moisture.

Abstract in Chem. Abs. 52(7):5690. Apr. 10, 1958. 381 Am33C

302. *KIMURA, S. Foods p.ocessed by freeze-drying. (Jap) Shinku 4(3): 1961. Not in Natl. Agr. Libr.

303. *KIMURA, S., and others. Freeze-drying of foods. II. (Jap) Shinku Kagaku 9(1). 1961. Not in Natl. Agr. Libr.

304. KIMURA, S. Present aspects and problems on freeze drying of food. (Jap) Reito (Refrigeration) 36(410): 21-28, illus. Dec.1961. 295.8 R27

Includes illustrations of Vickers-Armstrongs semi-continuous freeze-drying equipment, double contact heat plate, and reference to American companies engaged in freeze-drying.

305. KIRSOP, B. Maintenance of yeasts by freeze-drying. Inst. Brewing J. 61(6):466-471. Nov./Dec.1955. 390.9 In7

Eighty-three freeze-dried yeast cultures were examined for viability, fermentation reactions, and vitamin requirements.

306. KLIS, J. B. Freeze-dried foods on contract. Food Processing 24(3): 68-70, illus. Mar.1963. 389.8 F7325

Describes facilities and discusses current and potential services available in custom freeze-drying plant.

307. KOCH, R. B. Dehydrated foods and model systems. Symp. Foods [Proc.] 2:230-251. Ref. 1961, pub. 1962. 389.9 Sy64

Discussion of lipid oxidation, a basic problem to be solved if dehydrated food industry is to grow. Main portion of material reflects research carried on at the Quartermaster Food and Container Institute for the Armed Forces. Freeze-dried materials were used in some of the studies.

308. KOLODNY, R. M. Freeze-drying in Europe today. Food Processing 23(1): 38-40,43-44, illus. Jan.1962. 389.8 F7325

Reviews various items being test-marketed by several European food manufacturers currently using this new processing method. Some of the most recent research being carried on centers around use of a combination radiant-microwave heating system. Among the foodstuffs are: Coffee, mushrooms, tea, celery, peppers, meat, fish, fruits, milk, and vegetables. Some of the brand names are included.

309. KRAMERS, H. Rate-controlling factors in freeze-drying. In Society of Chemical Industry. Fundamental aspects of the dehydration of foodstuffs, p. 57-66, illus. Ref. London, 1958. 389.3 So1

Discussion of the general behavior of a freeze-drying system as a whole. Takes up areas of interest for design purposes and for cost information. Permeability of the dry layer is treated rather extensively. Some of the major difficulties involved in continuous freeze-drying are mentioned.

310. KUPRIANOFF, J. Some factors influencing the reversibility of freeze-drying of foodstuffs. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 16-24, illus. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

Discussion centers around changes caused by transformation of water from liquid to solid state and its removal as vapor. Five steps are suggested for minimizing product damage resulting from freeze-drying.

*Not examined

311. *LAMBERT, J. B. Heat and mass transfer in freeze-drying. Madison, Wis. 1956. 253 p. 295 L17

Thesis (Ph.D.) - University of Wisconsin.

Studies the effect of rate of energy input, vacuum, condenser temperature, tray loading, and nature of the frozen material being dried on the rate and temperature level at which drying occurs. Whole milk, baker's yeast, and a bacterial suspension were used in the investigation. The pilot freeze-dryer was radiant-heated.

Abstract in Diss. Abs. 16(11):2116. 1956. 241.8 M58

312. LAMBERT, J. B., and MARSHALL, W. R. Heat and mass transfer in freeze-drying. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 105-133, illus. Ref. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

Three objectives of the study were: To extend the freeze-drying theory to materials containing solids; to attempt to predict drying times and rates; and to arrive at data which would serve as basis for improved engineering design.

313. LAMBOU, M. G. Effects of curing, storage and dehydration on the mono- and di-saccharides of the sweet potato. Food Technol. 12(3):150-155. Ref. Mar. 1958. 389.8 F7398

Investigates changes in the main sugar components of sweet potatoes of the Unit I Porto Rico variety. Previous observations on changes occurring during curing and storage of the raw roots were confirmed here by the qualitative and quantitative results with deionized freeze-dried alcohol-soluble constituents of the sweet potato.

314. LAND, D. G. Stability of plant pigments. In Hawthorn, J., and Leitch, J. M., ed. Recent advances in food science, v. 2, p. 50-56. Ref. London, Butterworths, 1962. 389.9 H31

About instability of carotenoid pigments (covering oxidative and non-oxidative changes), summarizing the information from many studies on the subject. Brief reference to test with freeze-dried carrots.

315. LANG, O. 5. Gefriertrocknungstagung am 27. und 28. Februar 1962 in Koln [Fifth Freeze-Drying Conference, February 27-28, 1962, Cologne]. Kalte 15(4):198,201-205. Apr.1962. 295.8 K122

Report consists mainly of summaries of various papers presented. Includes reports by the following: L. R. Rey, G. Nemitz, H. Mohler, J. C. M. Meijer, R. Hamm, H. Ehlers, H. F. T. Meffert, C. P. Huysmans, J. Veldstra, and R. von Sengbusch.

316. LANG, O. Die Gefriertrocknung von Fleisch [The freeze-drying of meat]. Kalte 15(4):195-197. Apr.1962. 295.8 K122

Refers to reports by D. M. Doty, H. Wang, E. Auerbach, C. E. Weir, V. Bates, H. R. Kraybill, and N. Maynard.

317. LANG, O. Die Gefriertrocknung von Fleisch [The freeze-drying of meat]. Schlacht.-u. Viehhof-Ztg. 62(5):167-171, illus. May 1962. 286.85 D48

Description of the process and its resulting product.

318. LANG, O. Die Gefriertrocknung von Lebensmitteln [The freeze-drying of foods]. Kalte 41[i.e. 14](12):653-656,658, illus. Dec.1961. 295.8 K122

Discusses principles of freeze-drying, and describes design and operation of specific freeze-drying plants in the United States, England, Denmark, and Germany. Also a section on packaging of processed foods.

319. LAWLER, F. K. Latest in freeze-drying. Food Engin. 33(11):35-38, illus. Nov.1961. 389.8 F737

In spite of problems yet to be solved (namely, high costs, quality of food, and packaging) the outlook is for $2 billion sales by 1970. Ways now being undertaken to solve current problems are discussed with specific details, especially regarding costs. The market potential, Army requirements, and plant expansion in Europe, New Zealand, and Canada, are also reviewed.

*Not examined

320. LAWLER, F. K. London freeze-dry symposium. Food Engin. 33(12):37-39; 34(1):44-46, illus. Dec.1961 - Jan.1962. 389.8 F737

Technologists from England and 12 other countries attended the international symposium, held Oct.19-20, 1961, in London, which covered latest advances and problems in: Equipment, control, freezing, heat, vapor, vacuum, reconstitution, nutritional values, processing techniques, and packaging. Includes reports on material presented by the following: R. I. N. Greaves, T. W. G. Rowe, J. C. Forrest, B. C. Walker, A. L. Brown, C. G. Tucker, E. J. Rolfe, D. F. Hollingsworth, E. A. Woodward, R. Reynolds, and H. Thompson.

321. LEA, C. H. Chemical changes in the preparation and storage of dehydrated foods. In Society of Chemical Industry. Fundamental aspects of the dehydration of foodstuffs, p. 178-196. London, 1958. 389.3 So1

Primarily a discussion of browning-type reactions and lipid oxidations. In the various investigations reviewed, freeze-dried milk, beef, fish were among the foodstuffs that were studied.

322. LEA, C. H., and PARR, L. J. Some observations on the oxidative deterioration of the lipids of crude leaf protein. J. Sci. Food & Agr. 12(11): 785-790. Nov.1961. 382 So12

Antioxidants were added in an unsuccessful attempt to protect the lipid of the freeze-dried protein.

323. LEATHERMAN, A. F., and STUTZ, D. E. The application of dielectric heating to freeze-drying. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 92-105, illus. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

Discussion of the electrical engineering principles involved. Includes apparent limitations and suggestions for improvement in microwave freeze-drying.

324. LEDERMAN, A. N. Proper selection of freeze-dehydration equipment. In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p. 60-65, illus. Chicago, 1961? 389.3 R31

Describes the design philosophy of creative engineering based on specific circumstances and requirements, and illustrates its practical application. Includes discussion of significant cost and technical data in explaining equipment possibilities.

325. LEDERMAN, A. N., and LINDSTROM, F. H. Take a new look at freeze-drying. Food Engin. 33(10):41-45, illus. Oct.1961. 389.8 F737

Two executives of the Vacudyne Corporation present facts and figures to show the economical aspects of freeze-drying, along with a discussion of engineering and technical factors involved in the process. A diagrammatic sketch of a typical freeze-drying installation shows the basic simplicity of the process operations.

326. LEE, F. H. The new future for dehydrated foods. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 14(1):44-51. Mar.1962. 389.9 As74A

Military feeding systems include many freeze-dried foods in recent developments. Detailed information on some of these is given here (namely, beef, chicken, eggs, fish, pineapple, shrimp, and strawberries).

327. LEFEVER, S. E. H. Progress report from Britain on accelerated freeze drying. In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p. 54-59, illus. Chicago, 1961? 389.3 R31

Reviews equipment in current use; much of development here based on research done at Aberdeen. Describes different types of production plants designed, made, and sold. Includes sketch of a proposed continuous process AFD plant, and a table showing approximate cost of dehydration process.

328. LEVINE, I. M. New freeze-drying system with automatic control is devised. Food Mktg., Internatl. 1(6):15, illus. Dec.1961/Jan.1962. Libr. Cong.

Describes design and operation of the system (made up of a fully instrumented

drying chamber, freeze condenser, vacuum pump, heating system, refrigeration system, freezing cabinet for food, food trays and control panel) which has as its final function determining when the product is dry. Heat transfer here is by radiation.

329. LEWIN, D. N. Plant handbook data. Food Engin. 34(3):89-94,96-97. Mar. 1962. 389.8 F737

Presents brief summary of general fundamentals of heat transfer basic to calculations on the many operations involving heat in food processing. The table consists of six pages listing specific food products; for each it lists data on such essential food properties as: Storage temperatures, average freezing point, water content, approximate storage life, and others.

Although not specifically on freeze-drying, data are closely related to basic calculations in its development.

330. LEWIN, L. M., and MATELES, R. I. Freeze drying without vacuum: a preliminary investigation. Food Technol. 16(1):94-96. Jan.1962. 389.8 F7398

Investigates advantages and disadvantages of utilization of a freeze-drying procedure in which heat is supplied by a desiccated air stream at freezing temperature. Experimental apparatus and procedures are described, together with resulting data regarding carrots, peas, asparagus, blueberries, and chicken.

331. LIANA producing Wagerized shrimp on full-time basis. South. Fisherman 16(11):15,44, illus. Nov.1956. Libr. Cong.

Describes the steps involved in processing (including blanching, grading, peeling and deveining, arranging in trays, freezing, drying, and packing in vacuum sealed cans). Discussion also includes reference to type of equipment used in freeze-drying and reconstitution methods. Although institutional-size packs are the only size available at present, consumer-size are to be produced in the future.

332. LONG, A. Irish Sugar Co.'s accelerated freeze-drying plant. Food Trade Rev. 31(6):42-43, illus. June 1961. 389.8 F7334

This first full-scale commercial AFD plant will process approximately five tons of "wet" foods per day, including peas, carrots, French beans, potatoes, cauliflower, brussels sprouts, cabbage, and strawberries, as well as meats and seafood. Current and potential marketing plans for these foods (which will appear on the market under the brand name Erin Foods) are reviewed.

333. A LOOK at those new freeze-dried foods. Good Housekeeping 154(4):158. Apr.1962. 321.8 G61

Brief review of the new process, its advantages, current market, and general outlook.

334. LUYET, B. J. Effect of freezing rates on the structure of freeze-dried materials and on the mechanism of rehydration. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 194-211, illus. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

The bulk of the experimental data presented here were the result of research supported by the Quartermaster Research and Engineering Command.

335. LYNCH, J. S. Freeze-dried foods: market shaping up. Food Business 9(1): 32-34, illus. Jan.1961. 389.8 F7342

Advantages of new dehydrated products and the work of major companies in the United States and abroad engaged in this new process are reviewed. New marketing outlets include military, campers, explorers, civil defense, and foreign areas lacking refrigeration.

336. LYNCH, J. S. In Armour's kitchens: research pot at boiling point. Food Business 8(10):15-17, illus. Oct. 1960. 389.8 F7342

Armour is now building a food research laboratory and pilot production plant for its freeze-drying program. The advantages of freeze-dried foods and the potential as well as immediate market for them have spurred interest

in the new process.

337. MAAS, J. Contribution a l'etude de la viande de boeuf cryodessechee [Contribution to the study of freeze-dried beef]. Alfort. Ecole Natl. Vet. These 56, 52 p., illus. Ref. 1957. 41.2 AL23

Study of the properties, storage, and rehydration of freeze-dried beef. Among properties analyzed here were: Appearance, histological structure, density, and tenderness. A resume (in outline form) of results of the study is given on the last two pages.

338. MACDOUGALL, D. B. The formulation and development of composite precooked dehydrated foods. Food Processing & Packaging 30(352):3-10, illus. Jan.1961. 389.8 F738

Experiments were undertaken to determine the possibilities for commercial exploitation of various foods and food combinations dehydrated by accelerated freeze-drying technique. These included: Cauliflower and cheese sauce, leeks and cheese sauce, meat and vegetable stew, spaghetti in tomato sauce, rice and sago puddings, and chicken dishes. The preparation of each is described in detail, packaging requirements are discussed, and storage life considerations are included.

339. MACGREGOR, M. New freeze-drying of foods. Food Mktg. Internatl. 1(1): 10-11. Feb./Mar.1961. Libr. Cong.

Reviews briefly the successful use of freeze-dried foods on recent expeditions, a reference to developmental work by the British, and current commercial developments by many companies in the United States.

340. MCGREGOR, W. S. Packaging of dehydrated foods. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 10(2):85-88. June 1958. 389.9 As74A

Quick-serve dehydrated meals for the military present demanding container requirements. Handling, shipment, reconstitution needs, weight are all factors in design of packaging, as well as protection against oxygen and moisture. Three-ply film is one proposal for material to be used. The hope is expressed that industry will aid military in solving problems here and in developing successful packaging.

341. MCILRATH, W. J., DEKAZOS, E. D., and JOHNSON, K. R. Rehydration characteristics of freeze-dried plant tissue. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 211-217, illus. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

Experiments here were all carried out using Swiss chard leaf blades. Among the findings it was learned that the tissues that were frozen most rapidly rehydrated the most successfully; also, the less the cellular structure is disrupted during drying, the better the dehydrated product will be.

342. MAGUIRE, J. F. Freeze-drying moves ahead in US. Food Engin. 34(8): 54-56; (9):48-52, illus. Aug. - Sept. 1962. 389.8 F737

Considers optimistically the status quo of freeze-dried foods--their cost, quality, nutritive value--and discusses in some detail two of the general areas where improvement is still to be achieved (namely, proper preparation of the product before it is freeze-dried and better freeze-drying technique, including shorter drying cycles and the resulting economies).

Attention is given to such details as speed of drying, heat sources, automatic cycling, pumping vacuum, condensing, defrosting, cycle size. Also touches on packaging needs and proper rehydration research.

343. MAGUIRE, J. F. Freeze-drying today--equipment for tonnage production. In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p.93-97, illus. Chicago, 1961? 389.3 R31

Describes design of different units now available and discusses processing costs and product quality.

344. MAGUIRE, J. F. Low freeze-dry cost seen for big plant. Food Engin. 34(12):90-91. Dec.1962. 389.8 F737

Gives figures for power, utility, labor, and capital costs. These figures should be used only as a basic guide, however, since there are so many variables in methods of applying costs.

345. MAGUIRE, J. F. Vacuum freeze-dried foods are off to promising start in the market place. Natl. Provisioner 147(14):141-143. Oct. 6, 1962. 286.85 N21

Advantages and disadvantages of the new process are given, with special reference to potential consumer market. Includes discussion of the four general areas of control (i.e. preparation of product, processing techniques, packaging, and rehydration methods) for variations in quality of freeze-dried products.

An extended coverage of the cost considerations refers to power, utility, labor, and capital. Future lowering of costs will depend primarily on expanded market for goods and technical improvements.

346. MALLOW A. F. D. plant opened. Food Mfr. 36(7):275-279, illus. July 1961. 389.8 F736

Description of the Irish Sugar Company's accelerated freeze-drying pilot plant at Mallow, the first commercial venture into this new food processing technique. It is expected to be a boon to the Irish economy. The process, products, and plant are described.

347. MANFRE, B. L. The basics of freeze drying. Canad. Food Indus. 32(8): 40-42, illus. Aug.1961. 286.83 C166

Points out advantages and applications of freeze-drying and includes detailed information about equipment available, equipment and processing costs, and production rate.

348. MARSHALL, W. R. The current status of the theory and practice of drying. Chem. Canada 7(11):62,64,66,68,70,72, illus. Ref. Nov.1955. 381 C4236

Included here is a section on freeze-drying developments, pointing out briefly advantages and shortcomings.

349. MARTEM'YANOVA, K. B. Opytnoe khranenie ryby vysushenoi metodom sublimatsii [Experimental storage of fish dried by the freeze-drying method]. In Makarova, T. I., ed. Tekhnologiya Rybnykh Produktov [Selected articles from technology of fish processing], p. 161-169. Ref. Moscow, Pishchepromizdat, 1958. Libr. Cong.

Describes results of numerous experiments made studying storage behavior of freeze-dried fish. Observations are recorded about changes in taste, texture, and proteins. Different packaging methods and storage conditions are reviewed. Several tables accompany the article.

350. MARTIN, S. L. High vacuum technique. Chem. & Process Engin. 36(12): 423-428, illus. Ref. Dec.1955. 382 In8

Technical discussion of various pumps and factors affecting their speed and its measurement. Also a review of general techniques, distillation, evaporation, and drying. Several diagrams accompany the article.

351. *MASIKO, M. Freeze-drying of foods. (Jap.) Shinku 4(3). 1961. Not in Natl. Agr. Libr.

352. MASON, R. H. Long range impact of new food processes on frozen foods. Quick Frozen Foods 24(7):43-45,177, illus. Feb.1962. 389.8 Q4

Includes section on freeze-drying; discussion here covers reasons for high cost, advantageous features, its use in complementing other processes rather than competing with them, a list of companies involved in using the process, and those producing equipment for it. Outlook calls for continued research and development. A table showing comparative costs of food processing methods accompanies the article.

353. MATHESON, N. A. Absorption of atmospheric moisture by freeze-dried pork and fish. Nature [London] 184(4703, sup. 25):1949-1950. Dec. 19, 1959. 472 N21

Results of this investigation emphasize the importance, with regard to storage life, of preventing dried foodstuffs from picking up much moisture.

*Not examined

354. MATHESON, N. A. Enzymes in dehydrated meat. In Hawthorn, J., and Leitch, J. M. Recent advances in food science, v. 2, p. 57-64, illus. Ref. London, Butterworths, 1962. 389.9 H31

Reports progress made in experimental studies attempting to prove indirectly that enzymes are responsible for some of the changes in dehydrated meat during storage. Freeze-dried solutions were used in some of the studies. Among the results, it was demonstrated that enzymes in meat survive accelerated freeze-drying and storage.

355. MATHESON, N. A. Enzymic activity at low moisture levels and its relation to deterioration in freeze-dried foods. J. Sci. Food & Agr. 13(4):248-254. Ref. Apr.1962. 382 So12

Experiments here indicated that, due to enzymatic activity in raw freeze-dried foodstuffs, wherever extreme storage life is of major importance, precooked foods should be used.

356. MATHESON, N. A., and PENNY, I. F. Storage of dehydrated cod. Food Processing & Packaging 30(354):87-91, 98; (355):123-127, illus. Ref. Mar.-Apr.1961. 389.8 F738

Describes two storage tests with fish dehydrated by vacuum contact-plate drying process, and one test with AFD cod steaks. The effect of moisture content, temperature, and packing atmosphere was observed. A taste panel evaluated the food samples.

357. MATSUMOTO, J. Denaturation of fish protein by freeze drying. (Jap.) Reito (Refrigeration) 36(410):1110-1119. Ref. 1961. 295.8 R27

358. *MATZ, G. Possibilities for the technical execution of freeze-drying. Vakuum-Tech. 3:115-123. Ref. 1955. Not in Natl. Agr. Libr.

Points out that solid material should be divided and distributed in thin layers. Processing can be carried out either by use of a vacuum-tube or a vacuum-cabinet drier.

Abstract in Chem. Abs. 49(10):6661. May 25, 1955. 381 Am33C

359. MAUGHAN, J. The great soup war. Dun's Rev. & Mod. Indus. 78(3):29-31, illus. Sept.1961. 286.8 D92

Discussion of the current vying between the big soup companies for advantage in the lucrative dehydrated soup market. Campbell's Red Kettle (freeze-dried) line is a leading contender. The potential growth of the market for soups points to continued lively competition.

360. *MAXA, V., and TEPLY, M. Ucinnost suchych cistych mlekarskych kultur a jejich pouziti v praxi [The activity of dried dairy cultures and their use under manufacturing conditions]. Prumysl Potravin 11(11):589-595. 1960. Not in Natl. Agr. Libr.

A study of activities of freeze-dried cultures (e.g. of Cream, yoghurt, and Emmental cheese) for up to two years after their preservation. Conclusions indicate that dried cultures should be protected from light, moisture, and should be stored at low temperatures.

Abstract in Dairy Sci. Abs. 23(5): 230. May 1961. 241 Im76

361. *MAXA, V., and TEPLY, M. Vyroba susenych, mlekarskych kultur pro mlekarny zdravotnictvi a export [Preparation of dried cultures for dairies, medicine and export]. Prumysl Potravin 11(9):465-468. Ref. 1960. Not in Natl. Agr. Libr.

A method for freeze-drying cultures is described.

Abstract in Dairy Sci. Abs. 23(5): 230. May 1961. 241 Im76

362. MEAT products. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 12(3):215-221. Sept.1960. 389.9 As74A

Cites advantages of freeze-dried foods and notes that they provide basis for two new military feeding systems.

363. MEAT protein essence, freeze-dried foods offer exciting prospects for new products. Food Technol. Austral. 12(10):587-588. Oct.1960. 389.8 F7333

Brief, superficial review of the process and its promise.

*Not examined

364. MEHRLICH, F. P. Economic outlook for freeze dehydrated beef. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 12(2):130-135. June 1960. 389.9 As74A

Taking into consideration the advantageous characteristics of freeze-dried meat, and the results of an estimated cost study of processing, packaging, and transportation, the Quartermaster Food and Container Institute feels that these food components have a reassuring potential and warrant further research.

365. MEHRLICH, F. P. Freeze-drying: what it is and what it costs. Canad. Refrig. & Air Cond. 28(2):14-17, illus. Feb.1962. 295.8 C16

Both theoretical and practical aspects are covered. Includes a brief analysis, supplemented by two detailed tables, of capital and daily operating costs based on a recent study by the National Research Corporation, Massachusetts, under a Quartermaster contract.

366. MEHRLICH, F. P. Frozen food technology and packaging. Chem. & Indus. 2:31-34. Jan. 10, 1959. 382 M31C

Includes section on freeze-dehydration, which explains briefly the process, the end product, and the outlook.

367. MEHRLICH, F. P. Novel development can lower freeze-drying costs. In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p. 43-50, illus. Chicago, 1961? 389.3 R31

Deals with some theoretical and practical aspects of freeze-drying meat. Describes in detail the design and construction of a grid heater developed in the effort to reduce drying time. Reviews pilot-plant modifications made in attempt to arrive at data on drying characteristics of contrasting products. Also, work centering on improving vapor removal systems is included. Two tables reflect estimates of capital and daily operating costs of freeze-drying.

368. MELLOR, J. D. Accelerated freeze-drying of foodstuffs. Food Preserv. Q. 22(2):41-48, illus. Ref. June 1962. 389.9 Au7F

Covers brief historical background of freeze-drying; its principles (including discussion of heat and vapor transfer), equipment and operating conditions in British accelerated freeze-drying plants, advances in developments in Germany, properties of freeze-dried foods, cost of accelerated freeze-drying, advantages of freeze-drying, and short reference to packaging.

369. MELLOR, J. D. Engineering aspects of freeze-drying foods. Refrig. Air. Cond. & Heating 15(10):38-39,41; (11): 38-39,42-43. Apr.-May 1962. 295.8 R255

Describes processes of freezing and sublimation. Includes details of heating methods, design of vacuum refrigeration, steam ejector plants, description of characteristics of freeze-dried products and their packaging, and analysis of various costs involved in the entire process.

370. MELLOR, J. D. A method for protecting the surfaces of some materials in freeze drying. Vacuum 4(3):341. July 1954, pub. Feb. 1957. 334.8 V13

Describes difficulties in freeze-drying apricot and peach purees. Through experimentation the study achieved a product of uniform texture and appearance which could be easily removed from trays.

371. MERYMAN, H. T. Introductory survey of biophysical and biochemical aspects of freeze-drying. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference. Chicago, Illinois, April 12-14, 1961, p. 1-13. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

Demonstrates the interdependence of all elements in the freeze-drying process, and attempts to show the ways in which cell injury may occur in the various stages of the process. Results show that taste and textural changes in freeze-dried foods are not necessarily unavoidable.

372. MERYMAN, H. T. Minimizing product damage - basic biochemical and biophysical approaches. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961,

p. 225-228. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

Points out that freeze-drying of food is not a simple problem in heat transfer or vacuum technique, that many basic principles still require much investigation, that, in fact, the food drying field is not yet really ready for technology, but is still a problem for scientists and experimental research.

373. MERYMAN, H. T. Principles of freeze-drying. N. Y. Acad. Sci. Ann. 85(2):630-640. Ref. 1960. 500 N484

General discussion includes consideration of various practical approaches to: Heat input and sublimation; water vapor transfer away from the drying boundary; reduction of vapor pressure at the specimen surface. Advantages and inadequacies are pointed out, with the hope that new techniques will result in increased efficiency and speed of drying thus bringing about broadened industrial applications.

374. MEYER, J. C. M. Drogen van champignons [Drying of mushrooms]. Champignoncultuur 6(1):10-13, illus. Jan./Feb.1962. 80 C35

Includes discussion of freeze-dried mushrooms.

375. MEYER, R. I., and JOKAY, L. Application of lyophilization to cheese products. I. Some observations on the characteristics and stability of freeze-dehydrated Cheddar, Brick, Munster, Blue, Cream, and Cottage cheese. J. Dairy Sci. 42(5):908. May 1959. 44.8 J822

Details of the experiment are outlined. Results showed that the flavor of the freeze-dried cheese was generally milder than untreated cheese. Freeze-drying methods for Cream and Cottage cheese showed superiority over conventional dehydration methods.

376. MEYER, R. I. Dairy, oil, and fat products. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 11(3):171-172. Sept.1959. 389.9 As74A

Discusses results obtained from freeze-drying various types of cheese, including Cottage, Cheddar, Brick, Munster, Blue, and Cream cheeses.

377. MILITARY needs hike pace of freeze dehydration. Package Engin. 6(11):97-100,102-105,107. Nov.1961. 280.38 P122

Progress and problems in flexible packaging for freeze-dried foods. Although research here stemmed from requirements for military rations, these developments have direct application in commercial area as well.

378. *MILITARY plans to use new package in field test of freeze dried meats. Food & Drug Packaging 4(3). Feb. 2, 1961. 280.38 F733

379. MILLEVILLE, H. P. Industry interest mounts in freeze drying. Food Processing 21(11):28-31, illus. Nov.1960. 389.8 F7325

Includes cost data, a theoretical analysis of the process, and some practical accomplishments to date.

380. MILLS, J. L. Packaging of AFD foods-progress report. Sales Appeal & Packaging Technol. 3(10):10-12,14,16, illus. Oct.1961. Libr. Cong.

Covers in some detail the work by manufacturers in developing suitable packaging materials and machinery. Also reports on progress in marketing the food items in the United States and abroad, pointing out advantages and problems in dealing with the new products.

381. MINK, W. H., and SACHSEL, G. F. Evaluation of freeze-drying mechanisms using mathematical models. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 84-92, illus. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

An investigation studying heat transfer and mass transfer, using beef muscle. Conclusion drawn from this particular study was that heat transfer was more important than mass transfer in limiting the drying rate.

382. MINK, W. H., and SACHSEL, G. F. Freeze-drying: food preservation method of the future. Battelle Tech. Rev. 11(6):9-13, illus. June 1962. 470 B32

Primarily concerned with discussing problem areas that need attention; these

*Not examined

include: Costs, product selection and pretreatment, technical problems of freezing and drying processes, packaging, storage, and rehydration. The future outlook is promising; but research emphasis must be placed on the process as a whole in order to understand and perfect the complex interrelationship of the different operations here.

383. MIRRLEES steam-operated vacuum equipment. Food Trade Rev. 31(12):62, 66. Dec.1961. 389.8 F7334

Describes design and operation of equipment, and cites instances showing its successful use in AFD process. Its advantages are reviewed.

384. MITCHELL, J. H. Control of changes occurring in beef during dehydration and subsequent storage. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 5(4):296. Jan.1954. 389.9 As74A

Findings seem to indicate that storage under nitrogen and at low temperatures might lessen fat changes due to oxidation.

385. MITCHELL freeze-drying plant. Food Trade Rev. 31(11):37-38,44, illus. Nov.1961. 389.8 F7334

Describes British commercial plant which processes coffee extracts. Covers experience in the development of most acceptable extract and includes detailed discussion of basic equipment design, pilot plant, commercial production plant, and development of processing techniques. Although at present the semi-continuous batch multi-cabinet system is best, continuous freeze-drying plants are under investigation.

386. MOHLER, H. Bewertung getrockneter Lebensmittel [Evaluation of dried foods]. Mitt. aus dem Geb. der Lebensmtlunter-such. u. Hyg. 52(6):526-538. Ref. 1961. 389.9 Sw6

English summary.

Freeze-drying is one of the dehydration processes listed here. Discussion covers reconstitution test and brittleness test for dried foods.

387. MONTANO, G. H., LUH, B. S., and SMITH, L. M. Extracting and refining avocado oil. Food Technol. 16(2):96-98,101. Ref. 389,8 F7398

The investigation was made to find a way to improve economic returns to avocado producers since the oil contained in avocados (approximately 15 percent) is edible or suitable for pharmaceutical purposes.

Included here are experimental materials and methods used in freeze-drying avocados to 4 percent moisture content; oil recovery from these was over 94 percent. Also, there was no apparent heat damage or oxidative deterioration of the oil as a result of freeze-drying.

388. MORAND, C. Le sechage sous vide des produits alimentaires [Drying food products under vacuum]. In Rey, L. R., and others. Traite de lyophilisation, p. 373-382. Paris, Hermann, 1960. Libr. Cong.

Discusses details of the process, results obtained with various products (beef, chicken, pork, fish, fruit, fruit juices, and vegetables), and future outlook.

389. MORICHI, T., and others. Studies on the lyophilization of lactic starter organisms. II. Physiological characteristics and acid producing activities of lyophilized cultures. (Jap.) Agr. Chem. Soc. Jap. J. 35(2):150-155. Feb.1961. 385 Ag8

N. Yano, R. Irie, and H. Kembo, joint authors.

No changes were seen in physiological characteristics.

Abstract in Dairy Sci. Abs. 23(8): 380. 1961. 241 Im76

390. MORSE, R. E. Preparation and storage stability characteristics of dehydrated sausage products. (Abs.) U. S. Off. Tech. Serv. U. S. Govt. Res. Rpt. 37(3):146. Feb. 5, 1962. 157.8 B47

Freeze-dried sausages were tested for seven months regarding the following factors: Storage temperature, moisture content, salt level, antioxidant level, and length of storage period.

391. MORSE, R. S. High vacuum technology. Indus. Engin. Chem. 39(9):1064-1071, illus. Ref. Sept.1947. 381 J825

Technical discussion, one part of which relates to freeze-drying. Included here is reference to production of orange juice powder and concentrate.

392. MOYER, J. C., and STOTZ, E. The freeze-drying of foods--a look into the future. Farm Res. 12(1):16-17, illus. Jan.1946. 100 N48A

Experimental stage of the new process is reviewed. Compares vegetables and fruits dried in conventional way with those dried by sublimation.

393. MOYES, P. V. Freeze drying is here. Food Canada 21(5):19-21, illus. May 1961. 389.8 F7323

Description of the plant operated by Essex Packers includes its products, its operation processes, and its equipment. Reference is made to the successes experienced to date and also to unsolved problems.

394. MUGGLETON, P. W. Freezing and drying; Institute of Biology's Second International Symposium. Chem. & Indus. 32:997-998. Aug. 9, 1958. 382 M31C

Summary of reports given, centering for the most part around investigation of causes of death of living cells involved in these processes. Although mainly on biological aspects, studies were also concerned with basic, general data.

395. MULLIGAN, W. J. Freeze-drying--an exciting future. Broiler Indus. 24(4):48-49, illus. Apr.1961. 47.8 N45

Survey of the present status of freeze-drying: Brief explanation of the process; commercial companies now engaged in it; advantages and disadvantages; and immediate and long-range expectancy and potential.

396. MULLIN, J. W. Sublimation in theory and practice. Indus. Chem. 31(370):540-546. Ref. Nov.1955. 382 In22

Comprehensive review, including design calculations and discussion of industrial applications. States that use of freeze-drying for foodstuffs, though uneconomical at present, will undoubtably become a major process in the future.

397. MUNDAY, K. A., EDWARDS, M. L., and KERKUT, G. A. Free radicals in lyophilised food materials. J. Sci. Food & Agr. 13(9):455-458. Ref. Sept. 1962. 382 So12

Minced beef, herring, and maize were among the items dried by accelerated freeze-drying in the investigation. Among the findings it was noted that the free-radical concentration increased in AFD food when exposed to air and oxygen, as well as when it was heated to 100°C. Observations here have been supplemented with other feeding experiments, all of which have established the fact that freeze-drying has no significant harmful effect on nutritive value of fresh food.

398. NAIR, J. H. Faster packaging improvements needed for freeze-drieds. Food Engin. 34(6):44-46, illus. June 1962. 389.8 F737

New developments are complicated by conflict between convenience and protection. A new concept, still in conjecture area, entails coating each material with a water-soluble, edible substance capable of giving the right amount of protection.

399. NAIR, J. H. Freeze-dried coffee. World Coffee & Tea 3(4):37-38. Aug. 1962. 286.83 W89

Describes equipment and details of processing by the first commercial firm to produce this new instant food item. Originating in England, the flavorful powder is now being produced in the United States by a leading plant.

400. NAIR, J. H. Freeze-dry systems changing. Food Engin. 34(6):41-43, illus. June 1962. 389.8 F737

Although batch freeze-drying with several chambers seems to be the most feasible processing for dehydrating a variety of products, it is felt that the continuous process would be most profitable for single product operations. For this reason, current trends are aiming at designing a truly continuous commercial freeze-dryer. Some

of the development work, aimed at achieving specifically designed equipment and installations for a successful continuous process, is discussed.

401. NAIR, J. H. Freeze-drying; where it stands in Europe. Food Engin. 33(3): 31-34. Mar.1961. 389.8 F737

A resume of the author's observations on freeze-drying progress in each of several European countries visited: Spain, Holland, Switzerland, West Germany, England, and Scotland. Included in the review are: A survey of vegetables that have been freeze-dried experimentally, details of equipment being used, costs involved, output, processing methods, as well as projected research areas and commercial potential of this new method of dehydration.

402. NAIR, J. H. German freeze-dry conference. Food Engin. 34(4):44-45, illus. Apr.1962. 389.8 F737

Review of the Fifth Freeze-Drying Conference, held February 27-28, 1962, at Cologne. Includes summaries of papers presented by the following: R. I. N. Greaves, L. R. Rey, G. Nemitz, R. Grau, R. Hamm, E. Thuse, C. P. Huysmans, R. von Sengbusch, and U. Hackenberg.

403. NAIR, J. H. A guide to freeze-drying at home and abroad. Food Canada 22(3):13-15. Mar.1962. 389.8 F7323

Review of current status of commercial application of freeze-drying in the United States, Canada, Great Britain, Holland, West Germany, Switzerland, and Italy. Includes names of companies and type of equipment used, food items, and brand names. A table listing all foodstuffs successfully freeze-dried accompanies the article.

404. NAIR, J. H. Point up freeze-dry phenomena. Food Engin. 33(5):57,61. May 1961. 389.8 F737

News review of speeches on many technical phases of freeze-drying presented at the Apr. 1961 international freeze-drying conference sponsored by the Committee on Foods of the National Academy of Sciences and the Advisory Board on Quartermaster Research and Development.

405. NAIR, J. H. Present status of commercial freeze-dried foods at home and abroad. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 13(4):186-190. Dec.1961. 389.9 As74A

Author surveys scope and potential of current operations by specific food companies in the United States, Ireland, England, Scotland, Holland, and West Germany. The increased number of installations, changes in equipment design, and varieties of equipment indicate the progress in commercialization of this new method of food preservation.

406. NEMITZ, G., and PARTMANN, W. Uber die Hitzeinaktivierung des Apyrasesystems der Muskulatur [Heat inactivation of the apyrase system of musculature]. Z. f. Lebensmtl.-Untersuch. u.-Forsch. 109(2):121-129. Ref. Feb.1959. 384 Z39

Freeze-drying of carp muscle was used in the study, which showed that freeze-dried material is significantly heat-stable.

407. NEMITZ, G. Vergleichende Untersuchungen uber die Wasserwiederaufnahme gefriergetrockneter und warmluft getrockneter Gemuse [Comparative research on the water reuptake in freeze dried and warm air dried vegetables]. Indus. Obst- u. Gemuseverwert. 47(14):409-412, illus. July 19, 1962. 389.8 K832

Shows that freeze-dried peas, beans, asparagus, carrots, celery, cauliflower, and mushrooms, when reconstituted, manifest a much faster water-uptake than similar food items that had been warm-air-dried. Freeze-dried and warm-air-dried onions appeared about the same; freeze-dried beans, asparagus, and mushrooms reached a much higher degree of reconstitution than warm-air-dried.

408. NEUMANN, K., and OETJEN, G. W. Automatic freeze-drying and its application to food products. Natl. Symp. Vacuum Technol. Trans. 5:258-261, illus. Ref. New York, Pergamon, 1958, pub. 1959. Libr. Cong.

Reference is made to certain advantages accompanying freeze-drying process. Points out that one of the biggest problems to be solved in

perfecting the process is measurement of temperature. Suggests that if automatic systems were to be installed in freeze-drying plants, output costs would be reduced considerably.

409. NEUMANN, K. Freeze drying: a modern application of refrigeration. (Abs.) J. Sci. Food & Agr. 10(10):ii-188. Oct.1959. 382 So12

Describes details for best results in freezing process. Characteristics of the frozen products are discussed, and advantages in the new method are included.

410. NEUMANN, K. Grundriss der Gefriertrocknung [Outline of freeze-drying]. Ed. 2. Gottingen, Musterschmidt, 1955. 256 p., illus. Ref. Libr. Cong.

Basically covers biological applications. Although only p. 157-158 are specifically on foodstuffs, entire book gives comprehensive coverage and general background data. Includes 28-page bibliography (p. 210-237) covering references prior to 1955.

411. NEW DEHYDRATED products bring soup rivalry to boil. Printers' Ink 277(10):11-12, illus. Dec. 8, 1961. 238.8 P932

Campbell Soup Company has a new line of freeze-dried soups on the market under the brand name of Red Kettle. Lipton uses freeze-drying with some of its soup ingredients also. The competition in the growing soup market is reviewed.

412. NEW DEHYDRATION equipment for army food research. Food Technol. Austral. 13(11):607. Nov.1961. 389.8 F7333

An accelerated freeze-dryer, built by Vickers-Armstrongs engineering works, has been imported for experimental work at Scottsdale in Tasmania.

413. NEW EQUIPMENT cutting the costs on freeze-drying. Frosted Food Field 33(1):14-15, illus. July 1961. 389.8 F922

Lists major companies now using the process, discusses its advantages and difficulties, and explains costs in terms of capital investment, operation, storage, and shipment. Packaging practice and package design are covered.

414. NEW FLEXIBLE-packaging developments for foods. Food Technol. 16(6): 40,43. June 1962. 389.8 F7398

Includes brief section on latest packaging materials for freeze-dried foods.

415. NEW LIGHTWEIGHT ham developed at OSU. Oreg. Agr. Prog. 9(2):14, illus. Summer 1962. 100 Or30r

Freeze-dried ham has good storage stability and reconstitutes easily and well, although it is somewhat inferior to cured ham in flavor. It should be of special interest to hikers, campers, and sportsmen.

416. NEW MICROWAVE freeze-drying technique. Food [London] 27(319):149-150, illus. Apr.1958. 389.8 F738

Describes advantages of this new process, which is still in laboratory stage, at the Raytheon Manufacturing Company's food laboratory.

417. NICKERSON, T. A., COULTER, S. T., and JENNESS, R. Some properties of freeze-dried milk. J. Dairy Sci. 35(1):77-85. Ref. Jan.1952. 44.8 J822

The study centered around determining whether freeze-drying techniques would produce a superior milk product than currently used methods. Results here proved negative.

418. NIKOLIC, N. Gefriertrocknung von Sauermilch [Freeze-drying of sour milk]. Milchwissenschaft 9(11):358-361, illus. Nov.1954. 44.8 M5933

Study shows that yoghurt milk can be freeze-dried to an excellent acidified powder which can be used for fermenting fresh milk. It also is valuable in nutrition.

419. NODERER, E. The food in your future. McCalls 83(9):92, illus. June 1956. Libr. Cong.

Gives details of new freeze-dried seafoods soon to be in national distribution. Under name Carvel Hall 99 Brand, they include oyster puff mix, crabcakes, crab imperial, and oyster bisque.

420. NUNES, W. T., and others. Report of a study of the digestibility and acceptability of a new dehydrated ration. U. S. Army Med. Res. & Nutr. Lab. Rpt. 258, 14 p. June 12, 1961. 152.9 R29

R. D. Powell, E. M. Nevels, and M. E. McDowell, joint authors.

"Quick-Serve Meal" is designation given to diet fed to nine human subjects in this study. An attempt was made to evaluate it. Results showed it to be digestible, and the subjects rated it highly when comparing it with similar fresh foods. Further evaluation under actual field conditions was recommended.

421. OETJEN, G. W. Continuous freeze-drying with automatic temperature control. In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p. 78-81, illus. Chicago, 1961? 389.3 R31

Describes and illustrates operation of the system.

422. OETJEN, G. W. The costs for freeze-drying food materials. In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p. 51-54. Chicago, 1961? 389.3 R31

Reviews various complex factors that determine cost estimations, and points out that calculations can be made only for specific examples.

423. *OETJEN, G. W. Freeze-drying of foodstuffs. J. Refrig. 4(1):10-12, illus. Jan./Feb.1961. Not in Natl. Agr. Libr.

Points out four considerations in satisfactory operation of the process and discusses factors affecting quality of the product, as well as production costs. Includes table showing estimated costs of freeze-drying fish, beef, and cauliflower. Also describes design of a continuous freeze-dryer.

Abstract in World Fisheries Abs. 13(1):31-32. Jan./Mar.1962. 414.8 W892

424. OETJEN, G. W., and others. Temperature-measurement and control of freeze-drying processes. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 178-190, illus. Washington, Natl. Acad. Sci., Natl. Res. Council. 1962. 389.9 F53

H. Ehlers, U. Hackenberg, J. Moll, and K. Neumann, joint authors.

"In summation: If the ice temperature is measured and used to maintain controlled conditions during the freeze-drying process, the calculated results of the process, based upon some fundamental measurements, will be in good agreement with the observable results." p. 190.

425. OLCOTT, H. S. Deteriorative reactions in stored freeze-dried meat and fish. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 74-76. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

Summary of findings from recent investigations.

426. OSMAN, H. O. A., and MORSE, R. E. Preparation and storage characteristics of freeze-dried sausages. I. Formulation and processing of comminuted sausages (frankfurters). (Abs.) Food Technol. 14(4):Insert 37. Apr.1960. 389.8 F7398

A study of behavior of freeze-dried frankfurter batter during preparation and rehydration. Factors considered included freezing rate, composition of batter, degree of chopping, thickness of batter, surface area. Rehydration methods are described, and a formula for calculating percent rehydration is presented.

427. OSMAN, H. O. A., and MORSE, R. E. Preparation and storage characteristics of freeze-dried sausage. II. Emulsion stabilization and rate of freeze-drying in comminuted sausages (frankfurters). (Abs.) Food Technol. 14(4):Insert 37. Apr.1960. 389.8 F7398

If fat-separation in frankfurter emulsion is minimized, it results in an increase in freeze-drying time. The study includes criteria for judging the use of an emulsifier or stabilizer in preparing freeze-dried frankfurter batter.

*Not examined

428. OSTROUKHOVA, Z. A. Sokhranenie svoistv vinnykh drozhzhei metodom liofil'noi sushki [Preservation of the properties of wine yeasts by the method of freeze-drying]. Mikrobiologiia 30(2):341-345. Mar./Apr.1961. 448.3 M582

English summary.

Favorable results were obtained when residual humidity ranged between 1.56 and 2.60 percent.

429. PACKAGE has 'Horseshoe nail' importance in distribution and storage of freeze-dried foods. Natl. Provisioner 146(20):26-27,34, illus. May 19, 1962. 286.85 N21

Comprehensive review of the needs, problems, and possibilities in adequate and ideal packaging of freeze-dried foods. Although certain general conditions must be fulfilled for successful packaging, each type of food must be considered individually with regard to most ideal package design and material.

430. *PACKAGING for AFD foods. Packaging Rev. 81(3):46-47. Mar.1961. Not in Natl. Agr. Libr.

Current developments aimed at flexible film pouch contained in an outer carton. Points out that in some cases vacuum packing alone may be sufficient; in other cases, nitrogen injection after vacuumization may be necessary.

Abstract in Packaging Abs. 18(6):376. June 1961. 309.8 P122

431. PACKAGING freeze-dry products. Food Canada 22(7):24. July 1962. 389.8 F7323

Brief review of necessary specifications to afford most protection.

432. PACKAGING machinery for A. F. D. foods. Food Mfr. 36(9):406-409, illus. Sept.1961. 389.8 F736

Describes and illustrates new Vickers machines designed to protect the products and also to be economical to operate.

433. PALMER, D. H., TAYLOR, A. W., and WITHERS, M. K. Texture, flavour and colour of air and freeze-dried vegetables. (Abs.) Food Trade Rev. 32(11): 37. Nov.1962. 389.8 F7334

Comparison of air-drying with freeze-drying by considering vegetables and soft fruits.

434. PARKER, M. E., HARVEY, E. H., and STATELER, E. S. Elements of food engineering, v. 3, p. 52-55, illus. New York, Reinhold, 1954. 389 P22

Deals with freeze-drying of liquid foods. A few basic engineering aspects are included, and it is pointed out that current economic data would limit the process to specialty food.

435. PARKES, A. S., and SMITH, A. U., ed. Recent research in freezing & drying. Oxford, Blackwell, 1960. 320 p. 295.9 P22

Report of Second International Symposium on Freezing and Drying. Twenty-two papers are included. Although none is about food, the material is recent and of general background interest.

Paper of significance to freeze-drying of foods is cited under individual author.

436. PARTMANN, W. Versuch einer strukturellen und funktionellen Analyse von Gefrierbrandschaden [Attempt at a structural and functional analysis of freezer burn damage in poultry]. Fleischwirtschaft 11(5): 347-350, illus. 1959. 280.38 F62

Reviews details of the study and discusses effects of ice sublimation in the freeze-drying process.

437. PARTMANN, W., and BERGER, A. Zur Einwirkung von Rontgenstrahlen auf die ATP-Spaltung von Fischmuskulatur mit verschiedenem Wassergehalt [Action of X-ray irradiation on the hydrolysis of adenosine-triphosphate in fish musculature of various water content]. Z. f. Lebensmtl.-Untersuch. u. Forsch. 107(4):327-340, illus. Ref. Apr.1958. 384 Z39

Freeze-dried fish was used in the

*Not examined

investigation. Among the findings it was observed that the apyrase system of frozen-dried fish muscle of three percent moisture is much more sensitive than that of fresh fish muscle.
Abstract in Chem. Abs. 52(16):13828. Aug. 25, 1958. 381 Am33C

438. PATTON, P. W. Freeze-drying looks up. Food Engin. 31(6):78-80, illus. June 1959. 389.8 F737
Cites advantages in freeze-drying as a commercial method of food preservation, and describes briefly various types of equipment and processes used. Tables show capital investment costs and plant operating expenses.

439. PATTON, P. W. Some considerations in equipment design for large scale freeze drying. In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p. 82-86, illus. Chicago, 1961? 389.3 R31
Lists nine general categories of variables encountered in freeze-drying of food and four major areas of consideration regarding equipment. Points out that successful system design (together with optimum economical operation) is to be based on an understanding of the complex interaction which takes place when the variables that foods introduce are matched against equipment possibilities.

440. PENDLINGTON, S., and WARD, J. P. The histological examination of air dried and freeze-dried vegetables. (Abs.) Food Trade Rev. 32(11):38. Nov.1962. 389.8 F7334
Carrots, parsnips, and swedes were used in the investigation which revealed that with air-drying total cell collapse was common, but with freeze-drying there was no cell collapse, although there was cell wall rupture.

441. PENNY, I. F. The effect of accelerated freeze drying on the colour of beef. Food Processing & Packaging 29(349):363-366. Oct.1960. 389.8 F738
Describes experiments undertaken to make quantitative measurements of the proportion of myoglobin derivatives in selected freeze-dried meat. Among the findings of the studies it was learned that the color of dehydrated beef is improved by dehydration at lower temperatures.

442. PENNY, I. F. Up-grading of low-grade meat. Chem. & Indus. 11:288-289. Mar. 12, 1960. 382 M31C
If meat is first dried by accelerated freeze-drying method, then reconstituted with proteolytic enzymes, a resultant tenderized product is achieved.

443. PETERS, L., and DAHLBERG, R. Torrkonservering av kött [Conservation of meat by drying]. Konserves 13(7): 73-79, illus. Ref. July 1955. 389.8 K835
Discussion covers hot air-drying, vacuum-drying, and freeze-drying.

444. PETERSEN, E. Accelerated freeze-drying of foods; some European advances. Frosted Food Field 33(3):11-13,41, illus. Sept.1961. 389.8 F922
Equipment is described in detail. Reference is made to rehydration process, discoloration, off-flavoring, vitamin loss problems, and heat transfer techniques.

445. PETERSEN, E. Development of dehydration from vacuum contact drying to accelerated freeze-drying. In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p. 66-72, illus. Chicago, 1961? 389.3 R31
Includes details of equipment design from earliest cabinets to latest models. Reference is also made to preparation of raw materials here, to use of dehydrated foods by expeditions and space travellers, and to a promising future outlook.

446. PETERSEN, E. Europeans probe accelerated freeze-drying. Food Engin. 33(6):33-36, illus. June 1961. 389.8 F737
Discussion of major engineering factors, including heat-transfer, vacuum equipment, as well as general quality criteria. Important considerations as to consumer acceptance of the resulting freeze-dried product center around rehydration ratio, discoloration, off flavor, and vitamin loss. Of concern, too, is the perfection of

adequate packaging materials and techniques.

447. PETERSEN, E. Freeze drying foods; the vacuum contact method. Food Canada 21(6):34-35, illus. June 1961. 389.8 F7323

Reviews briefly obstacles and problems in early techniques of food dehydration and research leading to successful industrial freeze-drying. Vacuum equipment is described and reference is made to automatic packaging machines developed in Sweden.

448. *PETERSEN, E. Industrial freeze-drying of foods. Canning & Packing 31(366):14-16; 31(367):8-9. 1961. Not in Natl. Agr. Libr.

In discussing the process and its resulting products, author touches on: Reconstitution with water, discoloration, flavor, vitamin loss, heat transfer, vacuum equipment, construction of installations, packaging, and future plans.

Also in J. Refrig. 4(3):55-58, illus. May/June 1961. Libr. Cong.

Similar article in Food Mktg., Internatl. 1(4):8-11, illus. Aug./-Sept.1961. Libr. Cong.

Also with titles:

Industriel frysetørring af fødevarer. Kulde 15(3):30-32; (4):43-44, illus. June-Aug.1961. 295.8 K95

Industriel frysetørring af fødevarer. Meieriposten 50(25):580-589, illus. June 24, 1961. 44.8 M47

Industriele vriesdrogen van levensmiddelen. Conserva 10(9):199-202, illus. Mar.1962. 389.8 F7632

Industrielles Gefriertrocknen von Lebensmitteln. Fleischwirtschaft 13(9):736-739, illus. Sept.1961. 280.38 F62

English summary.

Liofilizacion industrial acelerado de productos alimenticios. Rev. del Frio 6(2):53-60, illus. Apr./June 1961. 295.8 R324

English summary.

449. PETERSEN, E. Vacuum contact dehydration. Food Mktg. Internatl. 1(3): 8-9, illus. June/July 1961. Libr. Cong.

Reviews developmental steps in equipment design leading to type of plant suitable for freeze-drying of foodstuffs.

450. PETERSON, D. W. Source of chicken flavor. U. S. Qmaster. Food & Container Inst. Armed Forces. Surveys Prog. Mil. Subsist. Prob. Ser. I, Food Stability 9:167-173. 1957. 152.7 Su7

Discussion of reports centering on preparation of extracts to be used in chicken flavor study. Freeze-drying was used in the course of the investigation. It was demonstrated that a concentrate of chicken flavor precursors can be prepared by water extraction of lyophilized lipid-free muscle.

451. PETERSON, M. S. Freeze-drying equipment. Food Technol. 16(3):18-20, illus. Mar.1962. 389.8 F7398

Although there are only three broad basic problems to be resolved in designing freeze-drying equipment, theoretical and practical problems facing the engineers are numerous. Some of the problems affecting equipment design are delineated briefly, accompanied by schematic diagrams. Includes list of manufacturers either actively or potentially engaged in manufacturing freeze-drying equipment.

452. PIPPEN, E. L., and KLOSE, A. A. Effects of ice water chilling on flavor of chicken. Poultry Sci. 34(5):1139-1146. Sept.1955. 47.8 Am33P

Freeze-drying was one of the methods used in the investigation, which studied such aspects as the mechanism, chemical nature, extent, and importance of flavor changes. Among the conclusions here it was found that prolonged holding of chicken in cold water should be avoided since it is harmful to maintenance of best flavor.

453. PIPPEN, E. L., CAMPBELL, A. A., and STREETER, I. V. Origin of chicken flavor. J. Agr. Food Chem. 2(7):364-367. Mar. 31, 1954. 381 J8223

To improve commercial processing and storage conditions of poultry products various experiments were performed studying the chemical nature of poultry flavor. Broths prepared from freeze-dried chicken meat were evaluated. Findings showed that fat contributes to the aroma of broth, but is not important to flavor; also, flavor

*Not examined

depends more on the meat, rather than on skin and bones. Further investigations were felt to be necessary to extend application of findings beyond laboratory.

454. PLANK, R. Die Gefriertrocknung [Freeze-drying]. In Engerth, H., ed. Die Anwendung der Kalte in der Lebensmittelindustrie, p. 87-100, illus. Ref. Berlin, Springer, 1960. 389.3 En3

Covers the following sub-divisions: Characteristics of the freeze-drying process; explanation of apparatus used; selection of vacuum; freeze-drying of food; quality of preserved food; energy requirements; and packing and storing goods.

455. POINTS on freeze-drying made by QM committee. Food Engin. 34(4):102. Apr.1962. 389.8 F737

Brief evaluation of such miscellaneous new developments as: Overcooking in prehydration stage, continuous system, AFD process, application of infrared energy, liquid nitrogen immersion, and establishment of bacteriological standards for freeze-dried precooked foods.

456. POL, G., and GROOT, E. H. Studies over de invloed van op melk uitgevoerde bewerkingen op de voedingswaarde daarvan [Studies on the effect of processing on the nutritive value of milk]. Nederlands Melk- en Zuiveltijdschr. 14(3):158-175. Ref. July/Sept.1960. 44.8 N283

English summary.

Based on investigation of raw, pasteurized, sterilized, evaporated, spray-dried, and freeze-dried milk. Includes comparative data on such aspects as: Protein efficiency ratios, losses of non-conjugated unsaturated fatty acids, and B_1 and carotene.

457. PONZIANI, A. La crioessiccazione della carne [Freeze-drying of meat]. Vet. Ital. 10(8):692-693. Aug.1959. 41.8 C87

Brief coverage of basic process and its promise.

458. PRATER, A. R. An introduction to meat dehydration. Australia. CSIRO. Div. of Food Preservation and Transport. Food Preserv. Q. 20(4):68-74, illus. Dec.1960. 389.9 Au7F

Freeze-drying is one of the processes described briefly. New methods of improving heat transfer are expected to reduce drying times and costs without sacrificing quality.

459. PRESENT status of freeze drying surveyed. Natl. Provisioner 145(16): 12-14,16, illus. Oct. 14, 1961. 286.85 N21

Reference is made to both commercial and military developments. Extended discussion on packaging covers steps required, problems, and materials.

460. PRESERVING food without after effects. Engineering 190(4923):292, illus. Aug. 26, 1960. 290.8 En322

Details of the system used in accelerated freeze-drying are described and illustrated. Two future developments under investigation are continuous processing and use of infrared heating. The first commercial application of this process will take place in the Irish Sugar Company at Mallow later in the year.

461. PRODUCTION of accelerated freeze-dried foods. Food Trade Rev. 31(6):44-47. June 1961. 389.8 F7334

Discusses advantages of freeze-drying, and describes in detail design considerations, illustrated with diagrams of typical installations. Includes list of foods suitable for accelerated freeze-drying. Based on research report by Vickers-Armstrongs.

462. *PROGRESS in freeze-drying. World Fishing 9(12):64-67. Dec.1960. Not in Natl. Agr. Libr.

Describes sequence of operations in applying AFD process to fish. Resulting product is equal in flavor to that of quick-frozen fish, and there is practically no loss of vitamin, protein, or mineral content.

Abstract in U. S. Fish & Wildlife Serv. Com. Fisheries Abs. 14(5):7-8. May 1961. 156.2 C78

*Not examined

463. THE PROS and cons of meat dehydration. Canner & Freezer 124(8):14-16,30, illus. Apr. 15, 1957. 286.83 C16

With regard to freeze-drying, the process is briefly outlined, its limitations discussed, and packaging problems covered. The accomplishments of the Quartermaster Food and Container Institute are reviewed in the field of superior freeze-dehydrated products for the Armed Forces. Lists obstacles to be overcome before widespread commercial use is successful.

464. PRUTHI, J. S., and others. Effect of different methods of dehydration on the quality of garlic powder. Food Sci. 8(12):444-448, illus. Dec.1959. 389.9 M99

L. J. Singh, S. S. Kalbag, and G. Lal, joint authors.

Covers the effect of freeze-drying, vacuum shelf-drying, hot air-drying, and sun-drying on the retention of allyl sulphide, total sulphur, volatile reducing substances, antibacterial activity, color, and flavor.

Comparative results showed high investment and maintenance costs would make freeze-drying uneconomical in preparation of garlic powder for condiment purposes.

465. PUGACHEV, P. I. Izmenenie belkov pri khranenii belogo kurinogo myasa obezvozhennogo sublimatsionnoi sushkoi [Changes in protein during storage of hen white meat dried by sublimation]. USSR. Min. Vysshego Sred. Spetsial'nogo Obrazovaniya Izv. Vysshykh Uchebnykh Zavedenii. Pishch. Tekhnol. 6:85-87. 1961. Libr. Cong.

466. QM MILITARY - industry conference. Food Technol. 16(1):34-35. Jan.1962. 389.8 F7398

Discussions on freeze-drying center around current problems to be solved, plans for testing and producing successful products of a wide variety. Continuous cooperation between military and industry in attainment of superior freeze-dried items is emphasized. Includes long list of dehydrated items for which the Quartermaster Corps will soon have specifications or purchase descriptions.

467. QUESTIONS on food science put to panel of experts. Food Indus. So. Africa 14(8):29-30. Jan.1962. 389.8 F7372

Detailed answer to question about possibilities for accelerated freeze-drying of fish in South Africa. Points out that freeze-drying compares favorably with other drying techniques, lists the advantages of the resulting product, and discusses cost. Also refers to unsolved problems, such as storage stability and packaging. In all areas of the article reference is made specifically to fish.

468. *QUIRK, D. W. Modern microwave processing. Confectionery Mfr. 5(9): 341-342. 1960. Not in Natl. Agr. Libr.

Reference to freeze-drying of fruit products.

Abstracted in Brit. Food Mfg. Indus. Res. Assoc. Abs. Cur. Sci. & Tech. Lit. 13(6):276. June 1960. 389.9 B773

469. RADAR "spots" practical freeze-dry method. Natl. Provisioner 137(7): 23, illus. Aug. 17, 1957. 286.85 N21

Points out efficiency of new microwave technique and its expected advantages. Preliminary findings show that nutrients are better protected than by any other food processing method, and flavor of experimentally processed food was found to be about the same as cooked fresh product. Potential advantages in use by military are suggested.

470. RASMUSSEN, C. L., and VAN ARSDEL, W. B. New frontiers for freezing in the frozen food industry. Frozen Food Factb. & Dir. 1961/62:29,31,33. 389.8 F935

Freeze-drying, rather than being considered competitive as a process, should be looked upon as supplementary to frozen food industry; for it will be able to supply raw material for dehydration and to maintain storage facilities for items which have been dried to only five to ten percent moisture level.

471. RAUCH, A. C. New developments in dehydrating vegetables. Res. & Devlpmt. Assoc. Food & Container Inst. Activ.

*Not examined

Rpt. 10(2):74-77. June 1958.
389.9 As74A
An acceptable dehydrated whole kernel sweet corn was obtained by using a combination of freeze-drying and conventional air-drying.

472. RECENT studies on dehydration. Food Mfr. 32(11):515. Nov.1957.
389.8 F736
Describes investigation of freeze-drying peaches using four different conditions of heating. Studies were also made with freeze-dried samples of cod fillets.

473. RECOMMENDATIONS for reconstituting AFD foods. Food Trade Rev. 31(11): 43. Nov.1961. 389.8 F7334
Material excerpted from The accelerated freeze-drying (AFD) method of food preservation, by Gt. Brit. Ministry of Agriculture, Fisheries and Food, p. 126-128. 389.3 G797A

474. *REGIER, L. W. Chemical and physical changes during storage of freeze-dried beef. Davis, California. 1956. Not in Natl. Agr. Libr.
Thesis (Ph.D.) - University of California.

475. REGIER, L. W., and TAPPEL, A. L. Freeze dried meat. III. Non-oxidative deterioration of freeze-dried beef. Food Res. 21(6):630-639. Ref. Nov./-Dec.1956. 389.8 F7322
The study purported to point out the main physical and chemical changes that take place during the deterioration of freeze-dried beef in storage. Concluded that the only important non-oxidative deterioration of the meat was active carbonyl-amine browning. There was no loss in protein nutritive value in freeze-dried meat that was made organoleptically unacceptable due to deterioration.

476. REGIER, L. W., and TAPPEL, A. L. Freeze-dried meat. IV. Factors affecting the rate of deterioration. Food Res. 21(6):640-649. Ref. Nov./-Dec.1956. 389.8 F7322
The browning deterioration of freeze-dried beef was investigated. Attention centered on the role of temperature, water content, pH, concentration of carbonyl compounds, and the presence of inhibitors in effecting this deterioration. Ways to improve storage stability of freeze-dried beef are suggested.

477. REGIER, L. W., and others. The preparation and storage stability of freeze-dried beef. (Abs.) Food Technol. 8(5, sup.):42. May 1954. 389.8 F7398
M. R. Emerson, A. L. Tappel, A. Conroy, and G. F. Stewart, joint authors.
Conventional-plate and infrared radiation freeze-drying techniques were used. Resulting product is described, and three methods for increasing storage stability are included.

478. REPORT [of the] National Association of Frozen Food Packers, 20th annual convention, Dallas, March 5-8, 1961. Quick Frozen Foods 23(9):42-50, 176-177,200. Apr.1961. 389.8 Q4
Review of freeze-drying, p. 50, 176. Talks touched on general outlook, results with specific products, mechanics of the process, packaging requirements, advantages, and drawbacks.

479. REPORT on Raytheon apparatus puts spotlight on freeze-drying. Frosted Food Field 24(6):15-16, illus. June 1957. 389.8 F922
Microwave energy is used in the pilot plant, thus reducing the drying process by about 75 percent. Although developments here help make freeze-drying more feasible from economic standpoint, many disadvantages at present limit or deter widespread commercial use of new process.

480. REPORT on the First International Congress of Food Science and Technology. Food Mfr. 37(11):543-544,547-549. Nov. 1962. 389.8 F736
Held in London, Sept. 18-21, 1962.
Coverage is selective, not comprehensive. With regard to freeze-drying research, specific, but brief, reference is made to favorable and unfavorable findings (especially concerning various vegetables), as well as to investigative work on automatic

*Not examined

control. Attention is given to processing techniques, storage properties and packaging developments.

481. RESEARCH AND DEVELOPMENT ASSOCIATES, FOOD AND CONTAINER INSTITUTE. Freeze-dehydration of foods; a military-industry meeting September 20-21, 1960, Chicago, Illinois. Chicago, 1961? 108 p. 389.3 R31

Individual articles are cited under respective authors.

482. REUBELT, R. Freeze-dried shrimp. In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p. 36-37. Chicago, 1961? 389.3 R31

Traces the development by one commercial firm in the United States of its use of freeze-drying process. Although the primary food item here has been shrimp. some attention has been directed to future marketing of fruits (bananas, strawberries), vegetables (corn, peas, tomatoes), crab, lobster, and chicken.

483. REUTER, F. H., and DAY, W. R. Freeze-drying. Refrig. Air Cond. & Heating 15(2):28-29,31,33,35,37; (3): 42-43,45,47, illus. Aug.-Sept.1961. 295.8 R255

Gives historical background, detailed review of the process itself, description of equipment and operating conditions, discusses packaging and storage problems, current usage in the United States, Europe and Australia, and future trends.

484. REVIEW reveals program progress. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 11(3):188-209. Sept. 1959. 389.9 As74A

Comprehensive coverage of developments and problems yet to be solved in all phases of military rations research. The role of freeze-drying is reviewed throughout in pertinent sections. Experience with such items as meats, vegetables, concentrated cheese bars, fruits, yeast fermentation broths, cheeses, eggs is covered. Results and findings of various studies are detailed. Closely related fields are covered, such as nutrition research, chemical and microbiological research, and food acceptance studies.

485. REY, L. R. Aspects physico-chimiques de la congelation des tissus et de leur conservation par les basses temperatures [Physico-chemical aspects of freezing tissues and of their conservation by low temperatures]. Ann. Nutr. et Alim. 11(2):103-124. 1957. Libr. Cong.

Partial contents: 1, Phenomenes physiques de la congelation [Physical phenomena of freezing]; 2, La congelation des tissus animaux [Freezing of animal tissues]; 3, La conservation des tissus par les basses temperatures [Conservation of tissues by low temperatures].

Editor's note states that although the discussion does not apply specifically to food (but rather to biological materials) it has possible practical implications for the food industry in its current investigation and use of freeze-drying for various products.

486. REY, L. R. Automatic regulation of the freeze-drying of complex systems. Biodynamica 8(167):241-260, illus. Aug.1961. 442.8 B5223

The new method described here is based on the observation that a "pilot resistance", which will control the operation, may be determined for the system. Experimental tests demonstrate the regulation. Author points out the importance of accurate, efficient automatic control in modern industry for large scale production.

487. REY, L. R., and BASTIEN, M. Biophysical aspects of freeze-drying; importance of the preliminary freezing and sublimation periods. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 25-42, illus. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

Points out the three main types of products that can be freeze-dried and the minimum requirements for successful operation in each group. Various experiments are presented showing aspects of problems involved. Emphasizes the necessity of processing each given product in its own particular way.

488. REY, L. R. Systemes automatiques et mecanismes de regulation en lyophilisation [Automatic systems and regulation devices for freeze-drying plants]. Vide 15(90):456-468. Ref. Nov./Dec.1960. Libr. Cong.

Text in French and English.

Discussion covers general characteristics, different types, and total automatic operation. Includes reference to freeze-drying of foodstuffs.

489. REY, L. R., and others. Traite de lyophilisation [Treatise on freeze-drying]. Paris, Hermann, 1960. 412 p. Libr. Cong.

R. K. Andjus, R. Barone, J. M. Collins, J. Coudert, P. Goret, R. I. N. Greaves, P. Hauduroy, F. Henaff, G. W. Hyatt, P. Lepine, C. Merieux, C. Morand, K. Neumann, L. Rieutord, T. W. G. Rowe, and R. Wagner, joint authors.

Primarily biological application, but gives historical background and discusses general principles as well.

Section on freeze-drying of food, p. 373-382, by C. Morand. Discusses process results obtained with various products (beef, chicken, pork, fish, fruit, fruit juice, and vegetables) and future outlook.

490. RINFRET, A. P. Biochemical aspects of damage in freezing and freeze-drying of biological materials. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 43-49, illus. Ref. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

With regard to foodstuffs, the main reactions leading to degradation seem to be the oxidation of pigment, the oxidation of proteins and lipid, and the so-called browning reaction. This last reaction is closely connected with storage temperature and residual water content of the dried food.

491. ROBE, K. Good-bye mess sergeant; QMC is researching convenience foods. Food Processing 17(7):20-23, illus. July 1956. 389.8 F7325

A brief review of accomplishments in "foods of the future", including such freeze-dried items as beefsteaks, pork chops, fish-sticks, shrimp, and frankfurters. Five steps in freeze-drying beef rib eye are illustrated.

492. ROBSON, E. M., and ROWE, T. W. G. The physics of secondary drying. In Parkes, A. S., and Smith, A. U., ed. Recent research in freezing and drying, p. 144-166. Ref. Oxford, Blackwell, 1960. 295.9 P22

Examines and compares existing and proposed methods for achieving low final moisture content, taking into account efficacy, economy, and convenience. Includes discussion of difference between primary and secondary drying. Although much of the work reported here refers to biological freeze-dried materials, general principles are basic to the discussion.

493. ROLFE, E. J. An improved method for dehydrating meat. Food [London] 25(297):199-205, illus. June 1956. 389.8 F738

In the studies reviewed here, one theory that was tested involved freeze-drying the meat in order to produce a material that would reconstitute readily in water.

494. ROLFE, E. J. The influence of the conditions of dehydration on the quality of vacuum-dried meat. In Society of Chemical Industry. Fundamental aspects of the dehydration of foodstuffs, p. 211-224, illus. Ref. London, 1958. 389.3 So1

Covers both conventional and accelerated freeze-drying of meat in some detail. A small section on Canadian freeze-drying is included.

Abstract in Food Mfr. 33(6):251. June 1958. 389.8 F736

495. ROLFES, T., CLEMENTS, P., and WINTER, A. R. The physical and functional properties of lyophilized whole egg, yolk, and white. Food Technol. 9(11):569-572, illus. Ref. Nov.1955. 389.8 F7398

Standardized tests (angel cake volume test, mayonnaise stability test, and sponge cake volume test) showed respectively that freeze-drying had no adverse effect on the functional properties of albumen, but impaired the emulsifying properties of yolk, and the properties of whole egg.

496. ROVESTI, P. Isolisation et lyophilisation des derives vegetaux; leurs applications dans les industries alimentaires, cosmetologiques et pharmaceutiques [Isolization and lyophilization of vegetable derivatives; their application in food, cosmetological, and pharmaceutical industries]. Indus. de la Parfumerie 11(6):207-209; (7):255-258. Ref. June-July 1956. 308.8 In2

Includes fruit and vegetables.

497. *ROWE, D. M. The thiamine, riboflavin, and niacin content of chicken muscle as affected by freeze-drying. Columbus, Ohio, 1961. 107 p. Not in Natl. Agr. Libr.

Thesis (Ph.D.) - Ohio State University.

Investigation shows that that the nutritive quality of the chicken is not adversely affected by freeze-drying technique. In the studies on these vitamin values, comparisons are made: Between fresh, raw chicken meat, raw, dehydrated muscle, and raw, dehydrated, rehydrated cooked muscle; and between fresh, cooked chicken meat and cooked, dehydrated chicken meat.

Abstract in Diss. Abs. 22(11):3999. May 1962. 241.8 M58

498. ROWE, T. W. G. Theory and practice of freeze-drying. N. Y. Acad. Sci. Ann. 85(2):641-681. Ref. 1960. 500 N484

Detailed technical discussion with many diagrams and graphs. Includes about one page on freeze-drying of foodstuffs.

499. ROYO-IRANZO, J. Technical aspects of the production of concentrated fruit juices. (Abs.) J. Sci. Food & Agr. 11(3):i-147. Mar.1960. 382 So12

Vacuum-drying, freezing, atomization, and lyophilization are the techniques used here in processing citrus, apple, grape, and tomato juices.

500. *RZEDOWSKA, H. Comparison of methods for preservation of industrial yeasts. I. Properties of distillery yeasts immediately after lyophilization. Prace Inst. i Lab. Badawczych Przemyslu Spozywchego 9(1):1-21. 1959. Not in Natl. Agr. Libr.

Five strains of yeast were investigated.

Abstract in Chem. Abs. 54(5):5006. Mar. 10, 1960. 381 Am33C

501. SALWIN, H. Moisture levels required for stability in dehydrated foods. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 13(4):191-199, illus. Dec.1961. 389.9 As74A

Freeze-dried carrots, pork chops, peaches, apple slices, and fruit cocktail were among the food items used in studies here. The investigation centered around determining what is meant by moisture, and at what point the dehydration process should be stopped.

502. SALWIN, H. The role of moisture in deteriorative reactions of dehydrated foods. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 58-74, illus. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

Many studies are reviewed with such freeze-dried items as carrots, pork chops, peaches, apple slices, fruit cocktail. Among observations made here, moisture-vapor pressure measurements were found to be more meaningful than moisture determinations of dehydrated foods. In processing and packaging dehydrated foods, moisture-sorption data are important.

503. SAMUELS, E. R., and others. Studies on milk powders. IV. The foam and sediment fractions of reconstituted whole milk. J. Dairy Sci. 43(5):624-629. Ref. May 1960. 44.8 J822

A. Coffin, J. P. Julien, and B. E. Baker, joint authors.

Freeze-drying technique was used with the insoluble materials (both foam fraction and sediment fraction) recovered by centrifugation in one phase of the study.

504. SAVU, A., CIOBANU, A., and ADAM, G. Recherches sur la cryodessication de quelques products enzymatiques utilises dans l'industrie alimentaire [Investigations in the freeze drying of some enzymatic products used in the food industry]. Internatl. Cong. Refrig. Proc. 10(1):616-620. 1959, pub. 1960. 295.9 In82

Summary in English.

Pepsin and rennet were studied. The favorable results showed future industrial possibilities for their storage.

*Not examined

505. SCHRADER, H. Vierte Gefriertrocknungstagung in Koln [Fourth Freeze-Drying Conference in Cologne]. Kaltetechnik 11(8):268-269. Aug.1959. 295.8 K123

Summary of various papers presented at the conference, held Apr. 27-28, 1959. Includes reports by the following: K. Herrmann, K. Neumann, and L. R. Rey.

506. SCHUBERT, W. F. Freeze-drying of starter cultures. Queensland J. Agr. Sci. 16(4):409-418. Dec.1959. 23 Q37

Investigation was made to study methods available and factors involved in producing freeze-dried cultures. Outlines in detail two groups of experiments. Points out practical application of work here (namely, the use of stock cultures in dried state to be used in manufacture of cheese).

507. SCHULTZ, H. W., and ANGLEMIER, A. F. Investigation of the processing conditions necessary for the manufacture of highly acceptable, stable, pre-cooked freeze-dehydrated hams. (Abs.) U. S. Off. Tech. Serv. U. S. Govt. Res. Rpt. 36(10):S-32. Nov. 20, 1961. 157.8 B47

Studied the curing ingredients, temperature, and duration of precooking Factors affecting the stored product and rehydratability were determined.

508. SCIENTISTS take new look at dehydrated meat. Natl. Provisioner 138(23):24,38. June 7, 1958. 286.85 N21

Due to current high cost of freeze-dried meats, potential civilian market for them at present is limited to ourdoorsmen who can take advantage of the light weight and easy preparation qualities of the food. However, they offer possibilities for military use.

509. SCOTT, J., and ROLFE, E. J. The effects of dehydration and subsequent storage on the vitamins of the B complex in cod. (Abs.) Chem. & Indus. 19:583-584. May 9, 1959. 382 M31C

Brief discussion follows abstract.

510. SELF, R., ROLLEY, H. L. J., and JOYCE, A. E. Mixed fruit bars. Food Mfr. 36(9):373-376. Sept.1961. 389.8 F736

Describes accelerated freeze-drying techniques used in experimental studies with different fruit mixes composed of apples, peaches, bananas, apricots, blackberries, cranberries, and citrus fruits. Such details as the effect of sugar on reconstitution, moulding, packaging, storage life, and commercial possibilities are included.

511. SELTZER, E. Accelerating freeze-dehydration. In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p. 38-42, illus. Chicago, 1961? 389.3 R31

Traces early work and development of one firm in the United States in freeze-drying. Initial studies were made with peas; different drying techniques were used and results recorded, methods of heating compared, and design of trays was explored. Recent investigations by other research laboratories (e.g. rotary-type continuous freeze-dryer) are touched on and briefly evaluated.

512. SELTZER, E. Ideas for accelerating the freeze-drying process--basic physical and engineering principles. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 231-232. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

The moderator's summation of the major findings, together with their inter-relationship, of papers presented at this session of the conference.

513. SELTZER, E. Importance of selection and processing method for successful freeze-drying of chicken. Food Technol. 15(7):18,20,22, illus. July 1961. 389.8 F7398

Unusual care is required to achieve freeze-dried chicken meat that is not tough, stringy, or of poor shelf life. Five rules-of-thumb for selecting poultry suitable for dehydration are given, as well as four minimum requirements for the production of tender poultry.

514. SENGBUSCH, R. von. Probleme der Gefriertrocknung in Verbindung mit der Zuchtung von Beerenobst, Gemuse und Kartoffeln [Problem of freeze-drying in combination with the cultivation of berries, greens, and potatoes]. (Abs.) Kalte 15(4):205. Apr.1962. 295.8 K122

Presented at freeze-drying conference at Cologne, Feb.1962.

515. SERCHI, G. Esame di un liofilizzato di brodo e suo valore alimentare [Examination of a lyophilized broth and its nutritive value]. (Abs.) Chim. e l'Indus. 40(3):221. Mar.1958. 385 G43

A meat broth.

516. SHARP, J. G., and ROLFE, E. J. Deterioration of dehydrated meat during storage. In Society of Chemical Industry. Fundamental aspects of the dehydration of foodstuffs, p. 197-210. Ref. London, 1958. 389.3 So1

Freeze-dried beef, lamb, and pork were used in the studies. Both raw and precooked meats were investigated. Details of the experiments are given and conclusions listed. Although all dehydrated meats (regardless of method of preparation) deteriorate in storage, the storage life can be lengthened by drying to very low moisture contents. More rapid systems of freeze-drying have been developed to achieve these low levels more economically.

517. SHARP, J. G. Deterioration of dehydrated meat during storage. I. Non-enzymic deterioration in absence of oxygen at tropical temperatures. J. Sci. Food & Agr. 8(1):14-20. Ref. Jan.1957. 382 So12

Freeze-dried precooked pork was used in the study.

518. SHARP, J. G. Deterioration of dehydrated meat during storage. II. Effect of pH and temperature on browning changes in dehydrated aqueous extracts. J. Sci. Food & Agr. 8(1):21-25. Jan. 1957. 382 So12

Portions of freeze-dried pork were used in the study.

519. SHARP, J. G. Non-enzymic browning deterioration in dehydrated meat. In Hawthorn, J. and Leitch, J. M., ed. Recent advances in food science, v. 2, p. 65-73. Ref. London, Butterworths, 1962. 389.9 H31

The text is accompanied by a review of some of the findings of significant experimental studies, many of which used freeze-dried meats. Development of freeze-drying of products to low moisture content lengthens the potential storage life of dehydrated foods.

520. SHERWOOD, P. S. Commercial applications for freeze-drying. Canad. Refrig. & Air Cond. 27(12):16-18. Dec. 1961. 295.8 C16

Technological details are presented, as well as an extended evaluation of the four methods of heat transfer, with reference to food items. Key attractions of the new process are listed, and a resume of current operating pilot plants or semi-commercial units points to an expanding market for these new food products.

521. SHERWOOD, P. S. Freeze-drying of foods. World Refrig. & Air Cond. 12(11):43-45. Nov.1961. 295.8 W89

Developmental work in the United States and Europe is reviewed, including companies, products and markets. The technology is covered also, with details of heat transfer methods and vacuum requirements discussed.

522. SHERWOOD, W. Zur Wirtschaftlichkeit der Gefriertrocknung von Fleisch [Freeze-drying of meat becomes economic]. Fleischwirtschaft 14(4):304-306. Apr.1962. 280.38 F62

English summary.

Reports general status of progress in the United States and Europe; discusses technology of the process, including methods of heat transfer and vacuum requirements; and points out some of advantages of this new process.

523. SHOCKLEY, R. T. Packaging for freeze-dried foods. Frosted Food Field 33(4):36. Oct.1961. 389.8 F922

The degree and type of protection needed for each product determine the basis for developing most useful and economical containers. Test procedures

have been designed to evaluate a wide variety of materials for packaging.

524. SHOCKLEY, R. T. Picking pouch for freeze-dries. Food Engin. 34(12):100-101. Dec.1962. 389.8 F737

Types of laminates to be selected depend on specific requirements of the food items. Various degrees of protection must be provided (e.g. vegetables need intermediate protection; meats and fish need greatest protection). Article gives hints on selecting best packaging material. Includes tables outlining characteristics and uses of different laminates, and reference is also made to pouch costs.

525. SIDDAPPA, G. S., and RANGANNA, S. Strained baby foods. II. Drying of strained mango pulp and mango custard. Food Sci. 10(2):37-40. Ref. Feb.1961. 389.9 M99

Comparative study of the suitability of spray-, freeze-, and drum-drying techniques, with regard to stability of ascorbic acid and carotenid pigments, and the residual sulphur dioxide. Among the findings, it was noted that there is more retention of ascorbic acid in freeze-drying than in spray-drying. Generally, it was found that the freeze-dried mango powder was of a high quality.

526. SIDWELL, C. G., SALWIN, H., and KOCH, R. B. The molecular oxygen content of dehydrated foods. J. Food Sci. 27(3):255-261. Ref. May/June 1962. 389.8 F7322

The study was undertaken by the Quartermaster Food and Container Institute of the Armed Forces in an effort to obtain more information about the inherent storage stability of dehydrated foods. Describes a polarographic method for measuring oxygen content. Freeze-dried beef, chicken, and carrots were used in the study.

527. SIMONE, M., SHARRAH, H., and CHICHESTER, C. O. Instant bread mix: Consumer evaluation of prepared bread. Food Technol. 14(12):657-661. Dec.1960. 389.8 F7398

The study investigated experimentally the acceptability by laboratory and consumer panels of the appearance, texture, and flavor of instant bread mix prepared with freeze-dried, spray-dried, drum-dried and liquid flavors. Results showed that the laboratory panel ranked liquid flavoring highest in preference, followed by freeze-dried, spray-dried, and drum-dried; the consumer panel also ranked liquid the highest, with drum-dried, spray-dried, and freeze-dried following in that order.

528. SIMONE, M., SHARRAH, N., and CHICHESTER, C. O. Instant bread mix: variations in flavoring composition. Food Technol. 16(2):93-96. Feb.1962. 389.8 F7398

Freeze-drying figured in the processes studied in the investigation: The effect on bread flavor, texture, and volume made by variations in broth formula and fermentation procedure.

529. SINITSYN, A. Sushka metodom sublimatsii gotovykh k upotrebleniyu myasoproduktov [Drying by the sublimation method of meat products ready for use]. Myasnaya Indus. SSSR 31(2): 25-27. 1960. 50.8 M58

Study showed that freeze-drying of cooked meat results in higher quality of dried product than any other conservation process. Cooked freeze-dried beef, pork, and chicken meat were found to be very edible without further cooking.

530. *SINITSYN, A. V. Molecular drying of food products. Sovnarkhoz. Rostov. Ekon. -Admin. Raion. Byull. Tekh.-Ekon. Inform. 2:9-10. 1958. Not in Natl. Agr. Libr.

High quality, good storage stability, and economical transportation are among advantages discussed.

Abstract in Chem. Abs. 54(12):12405. June 25, 1960. 381 Am33C

531. SMIT, C. J. B. Some recent advances in food science. Food Indus. So. Africa 13(8):47-49. Jan.1961. 389.8 F7372

Section on accelerated freeze-drying discusses its superiority over conventional dehydration and shows how recent technological improvements in the process have now made it an economic possibility.

*Not examined

532. SMITH, D. B. Freeze-drying--a new process for the food industry. Confectionery Prod. 27(8):759,761-762,770, illus. Aug.1961. 389.8 C762

Brief review of some of the developments in freeze-drying by firms in Great Britain, Italy, Sweden, and the United States, and a discussion of the process itself, with reference especially to heat transfer and vacuum systems. Characteristics and advantages of the resulting food items are included. Among confectionery raw materials that have been successfully freeze-dried are: Egg white, whole egg, milk powder, fruits (e.g. strawberries, raspberries, apricots, apple rings, and banana slices), fruit pulps and juices (which have many applications as fine fruit powders in baby foods, as well as in bakery and confectionery items).

533. SMITH, D. B. Freeze-drying of foodstuffs. Bakers' Rev. [London] 78(13):531-532; (14):573-574, illus. Mar. 31-Apr. 7, 1961. 389.8 N214

Describes the development from a vacuum-drying process to accelerated freeze-drying, showing importance of heat transfer and pumping systems. Covers application of the new process to items of interest to bakers and confectioners (e.g. eggs, fruits, and fruit powders). Refers to one evaluative study that showed AFD eggs to be far superior to frozen and spray-dried eggs in all four tests.

534. SMITH, D. B. Freeze-drying of foodstuffs; a two-day symposium held on October 19th and 20th, 1961, at The Borough Polytechnic, London, Food Trade Rev. 31(12):51-58,66, illus. Dec.1961. 389.8 F7334

Summary of the proceedings. A list of the papers presented during the four sessions accompanies the report. The program covered the development of freeze-drying, products, commercial freeze-drying, packaging, marketing, research, and development.

535. SMITH, D. B. Freeze-drying--report of symposium held in London. Confectionery Prod. 27(12):1141,1143,1160. Dec.1961. 389.8 C762

Covered almost all phases of AFD process: Advantageous characteristics of the products; potential markets (government, institutional, industrial, household, with added reference to supermarkets and vending machines); commercial equipment; packaging; and current research (especially on heat transfer and continuous processing equipment). The trend seems to indicate a growth similar to, but not replacing that of frozen foods market.

536. SMITHIES, W. R. Canadian experience with dehydrated foods. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 9(4):292-294, illus. Jan. 1958. 389.9 As74A

Describes process of accelerated freeze-drying, pointing out its advantages over conventional freeze-drying. Mentions investigations in progress.

537. SMITHIES, W. R., and BLAKLEY, T. S. Design of freeze-drying equipment for the dehydration of foodstuffs. Food Technol. 13(11):610-614, illus. Ref. Nov.1959. 389.8 F7398

Describes and compares in tabular form five techniques used in freeze-drying foodstuffs . Discusses the design of a relatively simple large-scale drying unit using radiant heating from hotplates.

538. SMITHIES, W. R. The influence of processing conditions on the rehydration of freeze-dried foods. In Fisher, F. R., ed. Freeze-drying of foods; proceedings of a conference, Chicago, Illinois, April 12-14, 1961, p. 191-193. Washington, Natl. Acad. Sci., Natl. Res. Council, 1962. 389.9 F53

Reviews several conditions known to affect ability of product to be reconstituted with water. Examples are given of basic problems with meat, fruits, and vegetables.

539. SMITHIES, W. R. New developments in the freeze-drying of meat. (Abs.) Chem. & Indus. 29:1008-1009. July 20, 1957. 382 M31C.

Touches on details of the process, including time involved, cost, equipment, and characteristics of the dehydrated meat.

540. SMITHIES, W. R. Optimum processing conditions for freeze-drying. (Abs.) Food Trade Rev. 31(6):56. June 1961. 389.8 F7334

Points out that heat transfer plays major role in determining efficiency of the process.

541. SMITHIES, W. R. Problems and possibilities of freeze-dry. Food Canada 22(3):15. Mar.1962. 389.8 F7323

Digest of a talk given at a national packaging conference. Reviews the unique factors to be considered in dehydrating each of the following food categories: Meat and fish, vegetables, and fruits.

542. *SMOL'SKII, B. M. Drying food products by sublimation. Belorusskii Politekhnicheskii Inst. Sborn. Nauch. Trudov. 44:487-499. 1954. Not in Natl. Agr. Libr.

Describes process, including layout of plant, principle of its operation, and heat computation.

Abstract in Chem. Abs. 52(1):595. Jan. 10, 1958. 381 Am33C

543. SOCIETY OF CHEMICAL INDUSTRY. Fundamental aspects of the dehydration of foodstuffs; papers read at the conference held in Aberdeen, 25th - 27th March, 1958. London, 1958. 238 p. 389.3 So1

Individual articles are cited under respective authors.

544. SOME packaging materials for AFD foods. Food Trade Rev. 31(11):46. Nov. 1961. 389.8 F7334

Includes reference to metallic containers and non-metallic materials. Discusses briefly flexible materials, rigid containers (e.g. plastic, board), and glass.

545. SOUP battle nears the boiling point. Financ. World 116(11):19-20. Sept. 13, 1961. Libr. Cong.

Introduction of freeze-dried products into dry soup mixes has added to competition among leading soup producers. Current activity by these companies is reviewed.

546. SOUP'S on as mix masters square off; tv benefits as Lipton, Knorr, Campbell plan market battles. Broadcasting 62(26):28-29, illus. June 25, 1962. 335.8 B78

Campbell's freeze-dried soups, under Red Kettle brand name, have entered the market on a national scale. These are the only dry soup mixes packaged in hermetically sealed aluminum cans instead of laminated pouches. Spot TV advertising has been used to introduce them.

547. "STAR LITE" freeze-dried foods. Food Trade Rev. 31(8):37-38, illus. Aug.1961. 389.8 F7334

Discussion of this new range of AFD foods produced by Armour and Company covers their market potential, their diversity, advantages, and specific instructions for reconstituting and cooking individual items.

548. STEAM blanching vegetables for freeze-drying. Food Trade Rev. 31(12): 65, illus. Dec.1961. 389.8 F7334

Describes design features and basic operation of newly-developed steam/-scalder blancher.

549. STEINBERG, M. P. Development of techniques for the objective description of freeze-dehydrated cooked beef. (Abs.) U. S. Off. Tech. Serv. U. S. Govt. Res. Rpt. 36(7):111. Oct. 5, 1961. 157.8 B47

Reports some findings regarding tenderness, flavor, and storage.

550. STEWART-GORDON, J. Something new in groceries: instant everything. Reader's Digest 78(466):81-84. Feb. 1961. Libr. Cong.

Review of developments to date in freeze-drying, including reference to many food items processed, to market outlets, and to current production and research by many food companies in the United States and abroad. Traces background of its development from World War II and reports its potential outlook here and abroad.

*Not examined

551. STRESSES advantages of freeze-drying. Canad. Food Indus. 32(12):28. Dec.1961. 286.83 C166

Includes reference to preservation, cost, weight, storage, inventory savings, process saving, quality, and sales flexibility.

552. STUKIS, J. M. Effect of dehydration and rehydration on the histochemical and histological characteristics of beef. Res. & Devlpmt. Assoc. Food & Cont. Inst. Activ. Rpt. 5(4):289-290. Jan.1954. 389.9 As74A

Results of recent studies show that freeze-dried tissue is superior to other dehydrated tissue with regard to histological characteristics and rehydration rates.

553. *SUEZAWA, Y., and KAWAMURA, S. The mechanism of freeze-drying. (Jap.) Kogaku Kogaku 22:258-262. 1958. Not in Natl. Agr. Libr.

Abstract in Chem. Abs. 52(19):16630. Oct. 10, 1958. 381 Am33C

554. SUMMARY of the discussion on freeze drying of foodstuffs. Internatl. Cong. Refrig. Proc. 10(3):43-44. 1959, pub. 1960. 295.9 In82

Primarily about freezer burn and its relationship to freeze-drying process.

555. *SWANN, L. W. Accelerated freeze drying and the use of aluminium foils. Prod. Packag. 7(4):23-24,26. Apr. 1961. 280.38 P942

Suggests using foil as overwrap for cartons. Also considers problems of end folds.

Abstract in Packaging Abs. 18(7): 437. July 1961. 309.8 P122

556. SYSTEM freeze-dries 25 ton/day. Food Engin. 34(10):115, illus. Oct. 1962. 389.8 F737

Describes model of equipment: Its design, its operation, and output.

557. TAGUNG uber Gefriertrocknung in Koln [Freeze-drying conference in Cologne]. Kalte 12(10):525-528. Oct. 1959. 295.8 K122

Report on the Fourth Freeze-Drying Conference, held Apr. 27-28, 1959 in Cologne. Among the summaries of papers included here are reports presented by K. Herrmann, and K. Neumann.

558. TAPPEL, A. L. Efficient laboratory freeze-drying apparatus. Analyt. Chem. 26(10):1671-1672. Oct.1954. 381 J825A

Detailed description of design and operation of freeze dryer used mostly for drying irregular solids such as one-inch beefsteak and chicken parts.

559. TAPPEL, A. L., and others. Freeze-dried meat. I. Preparation and properties. Food Technol. 9(8):401-405. Ref. Aug.1955. 389.8 F7398

A. Conroy, M. R. Emerson, L. W. Regier, and G. F. Stewart, joint authors.

One-inch thick pieces of beef and various serving size pieces of meat, fish, and poultry were freeze-dried. Materials and methods used in the studies are described, as well as the resulting properties of the foods (color, structure, flavor, and texture) and their storage stability. Includes tables and graphs.

560. TAPPEL, A. L. Freeze-dried meat. II. The mechanism of oxidative deterioration of freeze-dried beef. Food Res. 21(2):195-206. Ref. Mar./Apr. 1956. 389.8 F7322

Among other findings in the investigation it was reported that if freeze-dried beef is stored in inert atmospheres or at high vacuum, main oxidative deterioration does not occur. However, such storage does not prevent the oxidation of myoblobin in the freeze-dried meat.

561. TAPPEL, A. L., MARTIN, R., and PLOCHER, E. Freeze-dried meat. V. Preparation, properties, and storage stability of precooked freeze-dried meats, poultry, and seafoods. Food Technol. 11(11):599-603. Nov.1957. 389.8 F7398

Many precooked freeze-dried foods were investigated (beef, pork, veal, lamb, chicken, turkey, salmon, oysters, shrimp, and tuna). Two detailed tables supplement descriptive material in presentation of conditions and results of the study.

*Not examined

562. TAPPEL, A. L., REGIER, L. W., and STEWART, G. F. High quality dehydrated meats. Calif. Agr. 9(10):4-5. Oct.1955. 100 C12Cag

Studies investigating the quality of freeze-dried meat showed resulting product with color, flavor, and nutrient value comparable to fresh foods.

563. TAPPEL, A. L., and others. Meat tenderization. II. Factors affecting the tenderization of beef by papain. Food Res. 21(3):375-383, illus. May/-June 1956. 389.8 F7322

D. S. Miyada, C. Sterling, and V. P. Maier, joint authors.

Finely ground freeze-dried biceps femoris was used in the investigation of papain digestion of beef proteins.

564. *TAYLOR, A. A. AFD demands new packaging concepts. Sales Appeal & Packaging Technol. 2(9):18-20,22,24. Sept.1960. Not in Natl. Agr. Libr.

Discusses causes of spoilage in this type of food preservation, and packaging requirements. Possibilities include: Metal, glass, plastics, for either rigid or flexible packs.

Abstract in Packaging Abs. 17(11): 660. Nov.1960. 309.8 P122

565. TAYLOR, A. A. Determination of moisture equilibria in dehydrated foods. Food Technol. 15(12):536-540. Dec. 1961. 389.8 F7398

In studying the behavior of water in dried foods, a rapid technique of evaluating the relations between equilibrium relative humidity (ERH) and moisture content by vapor-pressure measurement has proved successful. The method is described in detail. Its application to a variety of accelerated freeze-dried foods has provided useful data regarding dehydration and storage problems.

566. TAYLOR, T. C. Packaging of freeze-drieds. Food Engin. 33(9):41-44, illus. Sept.1961. 389.8 F737

Detailed discussion of past, present, and projected materials and methods of effecting containers that will: Keep oxygen and moisture content at a low level; protect against crushing; resist puncturing by food; be light in weight; and be economical. Current operations in the actual filling of packages with freeze-drieds are discussed. Two inserts give, respectively, a summary of potential and actual market outlets for freeze-dried foods, and a list of food firms currently marketing these products.

567. TCHIGEOV, G. B. Investigation and application of freeze-drying of foods. Internatl. Cong. Refrig. Proc. 10(3):31-35. Ref. 1959, pub. 1960. 295.9 In82

Although a patent for freeze-drying food in the USSR was issued in 1921, the process has been undergoing investigation only in the last 15 years. Soviet research has centered around perfecting methods of evaluating and improving drying processes and equipment. Freeze-drying is used mainly for drying meat and fish in the production of concentrated foods. Tables showing requirements for freeze-drying of certain foods accompany the article.

Summary in Internatl. Inst. Refrig. B. 39(3):876. 1959. 295.9 In7

568. TEASE, S. C. How Wilson & Co. freeze-dries meat. Canner/Packer 130(9):19-20, illus. Sept. 1, 1961. 286.83 C16

Describes steps in preparing, processing, and packaging the meat items. Problems yet to be overcome include: Consumer education, cost of production, and stability of products under storage. However, the long-term outlook is said to be promising.

569. THIS unit puts freeze-drying right on the processing line. Food Engin. 28(11):40-41,143, illus. Nov. 1956. 389.8 F737

Describes in detail the design and action of the new vacuum-contact unit at Kestrel Products, Aberdeen, Scotland.

570. THOMAS, M. H., and CALLOWAY, D. H. Nutritional value of dehydrated foods. Amer. Dietet. Assoc. J. 39(2):105-116. Ref. Aug.1961. 389.8 Am34

A detailed comparative study of the effects of dehydration, irradiation, and conventional thermal processing on the nutrient content of food items.

*Not examined

Detailed data on freeze-dried beef, chicken, pork, and shrimp are included throughout. Extensive tables accompany the article.

571. THOMPSON, H. Freeze-drying of foodstuffs. (Abs.) Food Trade Rev. 32(11):37. Nov.1962. 389.8 F7334

Covers pressures, heat transfer, pumping systems to remove water vapor, and various types of plants available for production.

572. THOMSON, J. S., and FOX, J. B. Effect of water and oxygen upon deteriorative changes in freeze-dried beef. (Sum.) Amer. Meat Inst. Found. C. 59:27-29. May 1960. 50.9 Am322C

Preliminary findings showed that moisture had more effect on sample deterioration than oxygen. It was also noted that with the increase of oxygen, moisture, and temperature levels in storage, rehydration was decreased.

573. THOMSON, J. S., FOX, J. B., and LANDMANN, W. A. The effect of water and temperature on the deterioration of freeze-dried beef during storage. Food Technol. 16(9):131-136. Ref. Sept.1962. 389.8 F7398

The investigation was made in order to try to arrive at some limits in these factors with regard to the principal deteriorative processes. The range of the moisture content of the beef here was 1.7 to 5 percent, and the storage temperature was held at different degrees. Results showed appreciable deterioration as the moisture content was increased and also as the storage temperature was increased. One of the conclusions confirmed that of a previous study, namely, that the moisture content of freeze-dried meat must contain less than two percent moisture to keep well.

574. THUSE, E., and ABBOTT, J. A. FMC freeze-drying equipment. In Research and Development Associates, Food and Container Institute. Freeze-dehydration of foods, p. 98-100, illus. Chicago, 1961? 389.3 R31

Describes plant facility available to food processors for economic, efficient processing of meat, fruit, and vegetables in 1000 pound batches.

575. THUSE, E. Der Gebrauch der Strahlungsheizung gegenuber der Kontaktheizung bei der Gefriertrocknung [Use of radiation heating compared with contact heating in freeze-drying]. (Abs.) Kalte 15(4):204. Apr.1962. 295.8 K122

576. TISCHER, R. G., and BROCKMANN, M. C. Freeze-drying ups quality of QM quick-serve rations. Food Engin. 30(1): 110-113, illus. Jan.1958. 389.8 F737

With military planners, freeze-drying has three outstanding features in its favor: Acceptability, cost, and combat effectiveness. Details are included on technique and products. One tabulated chart gives comparison with over 25 details between freeze-drying and conventional dehydration; and another shows transportation cost operation.

577. TISCHER, R. G. Quick-serve meals for the Army - why they're needed - what they comprise - how they'll be packaged. Food Engin. 29(2):64-67, illus. Feb.1957. 389.8 F737

Recent trends include more emphasis on new freeze-dried and dehydrated food items that may be easily reconstituted in field operations.

578. TKACHENKO, E. S. Soderzhanie vitamina s v yagodakh maliny, vysushennykh metodom sublimatsii [Vitamin C in raspberries dried by "sublimation"]. Konserv. i Ovoshchesushilnaya Promysh. 13(3):15. Mar. 1958. Libr. Cong.

579. *TKACHENKO, E. S. Vitamin B_1 content in freeze-dried fish. Rybnoe Khoziaistvo 38(2):72-73. 1962. 414.8 R962

580. TRAUBERMAN, L. Freeze drying makes new production strides. Food Engin. 32(11):98-99, illus. Nov.1960. 389.8 F737

Reviews Lipton's recent freeze-drying activities and general outlook, especially with regard to dry soup ingredients.

581. TRESSLER, D. K., and EVERS, C. F. Freezing preservation of foods. Ed. 3, completely rev. and augm., v. 1,

*Not examined

p. 612-623,625-626. Ref. Westport, Conn., Avi, 1957. 389.3 T72

Includes material on general principles, advantages, equipment, costs, and brief reference to specific processed foods, such as orange juice, meats, and shrimp.

582. TRESSLER, D. K., and JOSLYN, M. A. Fruit and vegetable juice processing technology, p. 335-336. Westport, Conn., Avi, 1961. 389.6 T72

Reviews in superficial way development to date of freeze-drying, with special reference to juices. Advantages of the process are cited, but difficulties and high cost of this method make it impractical for dehydrating fruit and vegetable juices at present.

583. TRESSLER, D. K. New developments in dehydration. Refrig. Engin. 66(3): 50,68. Mar.1958. 295.9 Am32J

Refers to recent successes in freeze-drying; points out its application to cooked shrimp and to other shellfish, as well as to both raw and cooked fish; and notes that dielectric heating speeds up the process and produces fine quality, although at a high cost.

584. TSEN, C. C., and TAPPEL, A. L. Meat tenderization. III. Hydrolysis of actomyosin, actin and collagen by papain. Food Res. 24(4):362-364. Ref. July/Aug.1959. 389.8 F7322

Among the materials used in the experimental studies here, supplementing previous research, was purified collagen prepared from defatted freeze-dried beef tendon powder.

585. TSEN, C. C., and TAPPEL, A. L. Oxidation of sulphydryl groups in denatured egg albumin. Canad. J. Biochem. & Physiol. 38(6):539-544. June 1960. 470 C16E

Freeze-dried denatured egg albumin was used in the study.

586. TUOMY, J. M., BUSCEMI, R., and BROCKMANN, M. C. Development of precooked, dehydrated meat items for military use. (Abs.) Food Technol. 14(4):Insert 21. Apr.1960. 389.8 F7398

Describes fish patty prototype item developed at the Quartermaster Food and Container Institute, which, if protected against moisture and oxygen, remains stable indefinitely, and which, when rehydrated, develops a texture like that of a freshly fried product.

587. TURNER, E. W. The future of dehydrated meat as a convenience food item. In Res. Conf. Proc. 8:37-45, illus. 1956. 50.9 C762

A discussion of the processing techniques used to produce raw and precooked freeze-dried meat products. Storage stability problems are considered, and illustrations are given of freeze-dried foods now being developed for the Armed Forces.

588. TURNER, E. W. Preservation of meat by freeze-drying. Natl. Provisioner 134(21):142-144. May 26, 1956. 286.85 N21

Covers the details, together with a discussion of the freeze-drying process, of the advantages and unique characteristics of freeze-dried foods, their potential by military and civilian consumers, their storage capabilities, shortcomings, and rehydration variations.

589. UNITED Fruit becoming a major producer of freeze-dried foods. Food Processing 22(12):25-26, illus. Dec. 1961. 389.8 F7325

Describes current status and future plans of one of the largest freeze-drying plants in the world. Among its products are shrimp, chicken, beefsteak, mushrooms, and asparagus. Although market outlets for these items are mainly institutions (such as hotels and restaurants) the Army Quartermaster Corps and other manufacturers purchase quantities.

590. VACUUM drying. Canad. Fisherman 44(2):22. Feb.1957. Libr. Cong.

Describes briefly spiked-plate freeze-drying process developed by Defence Research Board scientists and food technologists in Canada. Found to be highly satisfactory in processing meats, the new technique is to be investigated as a method of rapidly drying salt fish.

591. VACUUM freeze-drying tested for application in food field. Food Field Rptr. 29(8):36,38, illus. Apr. 24,1961.

286.83 F73
Includes a list of foods successfully processed by freeze-drying methods, and cites firms in the United States presently using systems for freeze-drying foods. Touches briefly on the highlights of this new process.

592. VERS des applications industrielles de la cryo-dessiccation a la deshydration des produits alimentaires [Commercial applications of the freeze-drying process for dehydration of food products]. Le Revue de la conserve 7:67,69. Sept.1957. Libr. Cong.
Scans the new process, outlining its problems and reviewing some of the investigative work in the United States, Canada, and Great Britain, pointing toward an optimistic outlook in future developments.

593. VICKERS accelerated freeze-drying equipment. Food Trade Rev. 31(12):59-60, illus. Dec.1961. 389.8 F7334
Points out its production of wide range of equipment designed to fill varied requirements of the food processing industry. Describes design and operation of research pilot plant, batch processing plant, and continuous freeze-drying equipment. Discusses methods of assessing costs.

594. VICKERS-ARMSTRONGS, Ltd. Commercial application of freeze drying (sublimation) to the preservation of food. Austral. Food Mfr. & Distrib. 30(11):20,22,24. June 5, 1961. 389.8 Au7
A discussion of the process, including design of systems and heat application. Accelerated freeze-drying is described. A list of foods suitable for accelerated freeze-drying is given.

595. VOSKRESENSKII, N. A., MAKAROVA, T. I., and MARTEM'YANOVA, K. W. Vliyanie razlichnykh sposobov susheniya na sokhranenie nativnykh svoistv myasa ryby [The effect of different drying methods on the preservation of the natural properties of fish meat. Vsesoyuzn. Nauch.- Issled. Inst. Morskogo Rybnogo Khoz. i Okeanografii. Trudy 29:69-83, illus 1954. 414.9 M85
Freeze-drying was the best dehydration method in this investigation.

596. *VOSKRESENSKII, N. A. Vliyanie sushki metodom sublimatsii na izmenenie svoistv myshechnoi tkani ryby [The effect of freeze-drying on fish muscle]. Vsesoyuzn. Nauch.-Issled. Inst. Morskogo Rybnogo Khoz. i Okeanografii. Trudy 40:5-20. Ref. 1959. 414.9 M85

597. *VOSS, E. Die Standardisierung der Butter- und Kaseherstellung durch langere Verwendung desselben gefriergetrockneten Saureweckers [Standardization of butter and cheese production by means of prolonged use of the same freeze-dried starter]. Milchwissenschaft 16(2):60-67. Ref. 1961. 44.8 M5933
Conclusion reached here is that freeze-dried cultures would be an asset, especially when used for large scale manufacture.
Abstract in Dairy Sci. Abs. 23(8): 380. Aug.1961. 241 Im76

598. WAGENKNECHT, A. C., LEE, F. E., and GRAHAM, R. J. The preparation of lipase from peas and the action of steapsin and pea lipase on crude pea lipid. Food Res. 23(5):439-445. Ref. Sept./Oct.1958. 389.8 F7322
The study shows that the bulk, and perhaps all, of the lipase prepared from peas is water soluble. Freeze-dried peas, with moisture content of about three percent, were used as well as fresh peas, since they are known to hold their quality in storage at minus 178° C. for relatively long periods of time.

599. WANG, H. Dehydration of meat. (Sum.) Amer. Meat Inst. Found. C. 12:59-62. July 1954. 50.9 Am322C
Research studies with freeze-dried beef to investigate its rehydratability. One practical finding showed that after partial lyophilization the dehydration could be completed at high temperatures without serious effect on rehydratability.

600. WANG, H., and others. A histological and histochemical study of beef dehydration. II. Influence of carcass grade, aging, muscle and electrolysis pre-treatment. Food Res. 19(1):154-161, illus. Jan./Feb.1954. 389.8 F7322

*Not examined

E. Auerbach, V. Bates, F. Andrews, D. M. Doty, and H. R. Kraybill, joint authors.

One of the two kinds of control used for each sample in the series of experiments consisted of meat frozen-dried in a specially constructed apparatus. The entire series consisted of studies with four carcass grades, three aging periods, and two muscles of the round.

601. WANG, H., and others. A histological and histochemical study of beef dehydration. IV. Characteristics of muscle tissues dehydrated by freeze-drying techniques. Food Res. 19(5):543-556, illus. Ref. Sept./Oct.1954. 389.8 F7322

E. Auerbach, V. Bates, D. M. Doty, and H. R. Kraybill, joint authors.

Among other findings, the study showed that the freeze-dried muscle tissue had no change in its total volume, revealed no sign of denaturation of muscle fiber protein, and was characterized by a space system which thoroughly interpolated dried muscle fibers. Furthermore, all samples rehydrated to over 85 percent of original moisture content and original muscle fiber diameter.

602. WANG, H., and others. The influence of enzyme tenderizers on the structure and tenderness of beef. In Res. Conf. Proc. 9:69-82, illus. Ref. 1957. 50.9 C762

C. E. Weir, M. L. Birkner, and B. Ginger, joint authors.

Twelve enzyme preparations were tested as to their effect on whole muscle tissue and separate components of freeze-dried steaks. Also, a taste panel evaluated steaks treated with some of these preparations in order to correlate tenderness with structural changes. The experiments are described and results summarized.

603. WANG, H., and AUERBACH, E. Structure and reconstitutability of beef muscle dehydrated by freeze-drying. (Abs.) Anat. Rec. 118(2):366-367. Feb. 1954. 447.8 An1

The successful rehydratability of the tissue here was observed to be due to the fact that when freeze-dried it became spongy, and the muscle fiber protein underwent no denaturation.

604. WANG, H., and MAYNARD, N. Studies on enzymatic tenderization of meat. I. Basic technique and histological observations of enzymatic action. Food Res. 20(6):587-597, illus. Nov./Dec.1955. 389.8 F7322

The muscle tissues used for enzyme treatment here included freeze-dried pork chops and beef rib eye, as well as raw beef outside round. The objectives aimed at were: Development of a basic technique of enzyme application to muscle tissue; comparison of this method with two conventional techniques; and observing the action of a commercial papain preparation and a fungal enzyme preparation on the meat structure.

605. WANG, H., and others. Studies on enzymatic tenderization of meat. III. Histological and panel analyses of enzyme preparations from three distinct sources. Food Res. 23(5):423-438, illus. Ref. Sept./Oct.1958. 389.8 F7322

C. E. Weir, M. L. Birkner, and B. Ginger, joint authors.

The objectives of the studies were: To investigate the action of 12 commercially available enzyme preparations on muscle tissue structure; to present panel data for those actually used for tenderizing freeze-dehydrated beefsteaks; and to evaluate the relationship of morphological to panel data.

606. WARD, K. Accelerated freeze drying. II. Fundamental design problems. Food Mfr. 36(2):60-63,66, illus. Feb.1961. 389.8 F736

A discussion of problems connected with equipment design, especially with regard to heat transfer and vacuum systems. Detailed tables supplement a review of costs associated with the drying process.

607. *WARM air drying is best for dehydrated fish. Fishing News 2246:3. May 4, 1956. Not in Natl. Agr. Libr.

Includes reference to results obtained with raw and cooked freeze-dried fish.

Abstract in World Fisheries Abs.

*Not examined

7(5):35-36. Sept./Oct.1956.
414.8 W892

608. WATTS, J. C., and CALBERT, H. E. A study of lyophilization as a means of preserving lactic starters. (Abs.) J. Dairy Sci. 37(6):639-640. June 1954.
44.8 J822

Investigated the influence of several factors, and compared cultures before and after freeze-drying. Basic findings are reported.

609. WATTS, J. C., and CALBERT, H. E. The survival of lactic starter organisms in the lyophilization process. Internatl. Dairy Cong. Proc. 14(2, pt. 2):619-629. Ref. 1956. 44.9 In8214

The factors investigated in this study included the type of culture, the medium used for growth and freeze-drying, physiological age of culture before lyophilization, and the storage time and temperature after freeze-drying. Among the findings it was learned that the most satisfactory medium was sterilized, ten percent reconstituted, nonfat dry milk; and storage below 0° C. increased survival potential of the freeze-dried starter organisms.

610. WATTS, J. C., and CALBERT, H. E. The use of a lyophilized lactic starter in the preparation of cottage cheese and cultured milk. (Abs.) J. Dairy Sci. 37(6):637. June 1954. 44.8 J822

Reports some data on the successful use and storage of the preparation.

611. WATTS, J. H., and others. The effect of various drying methods on the nitrogen and fat contents of biological materials. Food Res. 21(5):528-533. Sept./Oct.1956. 389.8 F7322

L. K. Booker, W. G. Wright, and E. G. Williams, joint authors.

Ground beef, homogenized cow's milk, and whole eggs were all dried in four ways: In air oven, vacuum oven, by infrared lamps, and lyophilizer. It was found that there was no difference statistically at the one percent level in percent N and fat retained in the results of the various drying methods on the foods investigated. However, the authors indicated a preference for the lyophilization method and its resulting material.

612. WEIR, C. E. Effect of proteolytic enzymes upon tenderness of dehydrated cooked beef. (Sum.) Amer. Meat Inst. Found. C. 51:52-54. July 1959.
50.9 Am322C

The study includes the action of enzymes upon precooked freeze-dried beef, and upon fresh beef which was later cooked and freeze-dried. Several differences were found in the effect of the enzymes on the two groups.

613. WEIR, C. E. Frozen-dried and dehydrofrozen foods. Amer. Meat Inst. Found. C. 60, 9 p. June 1960.
50.9 Am322C

Reviews general progress to date in freeze-drying of specific food products, pointing out successes, problems to be solved (especially with regard to texture and storage stability), and trends in major applications.

614. WEIR, C. E. Improving the quality of frozen dried steaks through application of proteolytic enzymes. U. S. Off. Tech. Serv. PB 145762, 27 p. 1958. 157.8 R29

615. WEIR, C. E., and others. Studies on enzymatic tenderization of meat. II. Panel and histological analyses of meat treated with liquid tenderizers containing papain. Food Res. 23(5): 411-422, illus. Sept./Oct.1958.
389.8 F7322

H. Wang, M. L. Birkner, J. Parsons, and B. Ginger, joint authors.

Freeze-dried steaks were rehydrated in a tenderizer solution for half an hour and subsequently similarly celloidin processed (in order to determine what effect over-treatment with liquid tenderizer would have on muscle tissue structure).

616. WEISER, H. Application of the freeze-drying process in food preservation. Milk Prod. J. 45(12):15-16,40-42. Ref. Dec.1954. 286.85 B98Bu

Summarizes objectives and principles involved in the process and reviews results of research, covering studies on such food items as: Peas, carrots, beets, orange juice, tomatoes, meats, milk, coffee and tea extracts, and eggs. Discussion covers characteristics of processed foods, their storage stability

and reconstitution, with brief reference to costs.

617. WELLS, G. H., MAY, K. N., and POWERS, J. J. Taste-panel and shear-press evaluation of tenderness of freeze-dried chicken as affected by age and pre-slaughter feeding of ions. Food Technol. 16(9):137-139. Ref. Sept.1962. 389.8 F7398

There was a difference between these two methods when measuring toughness of the freeze-dried samples, but close agreement when measuring non-freeze-dried items. It was thus indicated that shear-press measurements had limited value with freeze-dried chicken. Other findings with regard to tenderness, color, flavor, and rehydration are also reported.

618. WEYERHAUSER, M. Die Gefriertrocknung [Freeze-drying]. Verpackungs-Rundschau 13(5):460,462,464. May 1962. 280.38 V592

Covers principles, disadvantages, and packaging problems.

619. WHAT is this thing called freeze-drying? Distrib. Age 59(11):36. Nov. 1960. 288.8 T68

Brief survey of the process, its advantages, and its cost. A floor lay-out of a freeze-drying plant accompanies the discussion.

620. WHAT'S coming in freeze-drying. Food Engin. 35(2):64-67, illus. Feb. 1963. 389.8 F737

An overall review of the status quo and an estimate of trend of developments within the next few years. Estimates are made of amount of future market sales as well as potential marketing areas; costs are discussed; comparative flavor ratings made by a taste panel are included; specific food items are evaluated with regard to marketing possibilities; end-use potential of some items (as flavoring or seasoning ingredients, convenience foods, or specialty items), is mentioned. Some later developments in the United States and foreign companies, with regard to products, equipment, and methods are included.

A special chart on status of freeze-drying around the world, compiled by J. H. Nair, accompanies the article.

621. WHISTLER, R. L., GOATLEY, J. L., and SPENCER, W. W. Effect of drying on the physical properties and chemical reactivity of cornstarch granules. Cereal Chem. 36(1):84-90, illus. Jan. 1959. 59.8 C33

Air-dried and lyophilized starches were used in the experiments.

622. WIERBICKI, E., and DEATHERAGE, F. E. Russian meat industry aims high, makes progress, but must go far to match U. S. II. Natl. Provisioner 146(12):16-19,26, illus. Ref. Mar. 24, 1962. 286.85 N21

Mentions existence of an experimental pilot plant for freeze-drying in Smychka, Rostov-on-Don. Some freeze-drying has been done in Russia in the past.

623. WILSON and Co. Development of freeze-dehydrated precooked beef products; final report. Chicago, Quartermaster Food and Container Institute for the Armed Forces, 1958. 22 p. 152.71 D492

Summary of results of all previous preliminary reports giving information about the utilization of carcass. Emphasis is on the most efficient use of the cuts of the carcass and the approximate cost of the rations to the Quartermaster Corps. The eight products developed and discussed are: Beef mushroom saute; meatballs and gravy; beef chop-suey; sliced beef and gravy; beef slices and barbecue sauce; potted steak; and Swiss steak.

624. WINKLER, S., and JAGER, H. Uber die Eignung gefriergetrockneter Bakterienkulturen und uber Kulturen-aufbereitung in der Emmentalerkaserei [The suitability of freeze-dried cultures, and their propagation for Emmental cheese-making]. Milchwiss. Ber. 4(3):131-156. 1954. 44.8 M5997

625. WODICKA, V. O. Current status of the dehydrated foods program. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 11(2):77-81, illus. June 1959. 389.9 As74A

About quick-serve meals for the

military. Lists proposed menus and describes manner of preparation and general military use. Development work with products and processes yet to be carried on is included. Interest in the new foods includes future use by Navy (submarines) and Air Force (flight meals), as well as the Army.

626. WODICKA, V. O. Dehydrated foods in the U. S. Army feeding system. Res. & Devlpmt. Assoc. Food & Container Inst. Activ. Rpt. 10(2):69-73. June 1958. 389.9 As74A

Considers the advantages of these foods for military and includes a discussion of storage and stability problems. Necessity for industrial cooperation in production of such items is emphasized.

627. WODICKA, V. O. Feeding the army of tomorrow. Food Technol. 12(12): 667-670. Dec.1958. 389.8 F7398

Emphasis is being placed on dehydrated foods. Freeze-dried steaks and chops, to be packaged in flexible films if moisture and oxygen can be excluded successfully, are included in planning future military rations.

628. WORLAND, M. C., and URBIN, M. C. Some physical-chemical aspects of frozen and freeze-dried muscle. (Sum.) Amer. Meat Inst. Found. C. 59:25-26. May 1960. 50.9 Am322C

Reports development of a calorimetric method for determining the heat of rehydration of freeze-dried beef and pork muscle. Although not yet perfected, the technique shows promise. Other findings here tend to indicate that some water in meat remains unfrozen even at very low temperatures.

629. WUHRMANN, J. J., SIMONE, M., and CHICHESTER, C. O. The storage stability of freeze-dried soup mixes. Food Technol. 13(1):36-40. Jan.1959. 389.8 F7398

Compares flavor and storage stability of soup mixes made from conventionally dehydrated vegetables and from freeze-dried vegetables. Tables and graphs give specific details of moisture content, rates of water loss and of rehydration, and flavor analysis.

630. *YANO, N., and others. Studies on the lyophilization of lactic starter organisms. I. Survival in the lyophilization process and death of the dried bacteria during storage. (Jap) Agr. Chem. Soc. Jap. J. 34(12):1046-1049. 1960. 385 Ag8

T. Morichi, R. Irie, and H. Kembo, joint authors.

Among the findings, it was observed that survival of the organisms increased if the cultures were diluted with skim-milk before freeze-drying.

Abstract in Dairy Sci. Abs. 23(8): 380. Aug.1961. 241 Im76

631. YAO, A., NELSON, A. I., and STEINBERG, M. P. Factors affecting the rate of chicken meat dehydration under vacuum. Food Technol. 10(3):145-150. Mar.1956. 389.8 F7398

Factors studied included: Tray temperature, drier pressure, initial product temperature and moisture, precooking, sample thickness, type of muscle. Resulting organoleptic and rehydration data showed that low drier temperature, including freeze-drying, produced no apparent product quality advantage, compared to 130° F.

632. *YATA, K. Freeze-drying equipment for foods. (Jap) Shinku 4(3): 1961. Not in Natl. Agr. Libr.

633. ZAMZOW, W. H., and MARSHALL, W. R. Freeze drying with radiant energy. Chem. Engin. Prog. 48(1):21-32, illus. Ref. Jan.1952. 381 C4232

Investigation of a preliminary nature to describe the mechanism of freeze-drying by establishing drying time curves under various conditions. Results showed radiant heating to be more rapid than conduction heating, and that drying rates are influenced by moisture contents, nature of contact between the retaining medium and the frozen solid, and sample thickness.

634. ZIEMBA, J. V. Foods that are freeze-dried. Sci. Digest 51(5):69-71, illus. May 1962. 470 Sci27

An overall survey of the new freeze-drying processing of foods. Includes process itself, appearance of foods, problems to be solved, equipment necessary, and types of food already

*Not examined

successfully processed. Current plans and outlook, as indicated in the production and technological trends by specifically named companies, are surveyed.

635. ZIEMBA, J. V. Freeze-drying. Food Engin. 32(12):57-64, illus. Dec. 1960. 389.8 F737

A comprehensive coverage of current status and outlook: Advantages and problems, companies engaged in freeze-drying in the United States and abroad, equipment development here and abroad, and packaging practice. Costs are cited, marketing possibilities discussed, experience with specific food items is described, as well as processing techniques and trends.

636. ZIEMBA, J. V. New approach to freeze-drying. Food Engin. 35(3):41-45, illus. Mar.1953. 389.8 F737

Describes new plant featuring custom processing of freeze-dried food items. Includes blueprint and diagram of plant layout and diagram showing product flow. The workings of the system are explained, and its advantages (for quick market testing without capital investment, and for seasonal items) are cited.

637. ZIEMBA, J. V. Technologists create foods for air- and space-men. Food Engin. 30(3):50-53, illus. Mar. 1958. 389.8 F737

Mentions lipstick type, compressed, freeze-dried meats and poultry.

638. ZUCKERMAN, L. M. The processing of instant tea. Coffee & Tea Indus. 81(5):61,82. May 1958. 389.8 Sp4

Describes painstaking research and extracting production methods to determine best drying method. Lyophilization was one of methods investigated; however, gentle spray-drying proved the most satisfactory process.

AUTHOR INDEX

Numbers refer to items in list.

This list is provided to facilitate use of the bibliography. Journals containing seven or more references have been included.

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*Name changed to Journal of Food Science in 1961.